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ABSTRACT

A project was undertaken in Colorado to evaluate the feasibility of cost-benefit analysis as a source of information for local vocational administrators, to evaluate the effectiveness of a workshop for training these administrators in cost-benefit analysis, and to identify problems that prevent them from using this type of analysis in program development and evaluation. Based on a literature search conducted to determine the utility of cost-benefit analysis as a tool for decision-making by local vocational administrators, it was found that (1) certain conditions such as calculating costs and economic benefits and identifying target occupations must be met before conducting the analysis; and (2) while local vocational administrators can conduct cost-benefit research on their own, the pay-off in information is usually not worth the effort to obtain it. A one-day workshop was held, and fourteen administrative personnel attended. Following the training session, a mail survey of the participants showed that a majority felt an analysis designed solely to reveal monetary costs and benefits to be of minimal use in decision making. (The appendixes include survey and training materials, original project objectives and methodology, and a list of thirty vocational education outcome questions. Also included are the annotated references that resulted from the literature search.) (ELG)

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FINAL REPORT

Colorado RCU Project No. 78R-23

TRAINING LOCAL VOCATIONAL ADMINISTRATORS IN COST-BENEFIT ANALYSIS OF VOCATIONAL PROGRAMS

Sponsoring Agency: Colorado State Board for Community Colleges and Occupational Education Research Coordinating Unit

Principle Investigator: Dr. Harold R. Wallace
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Duration of Project: May 1, 1978 to June 30, 1979

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U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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I. INTRODUCTION

Cost-benefit analysis is a systematic procedure used to compare the economic cost of a program with the economic benefits expected to flow from that program. Applied to education cost-benefit analysis investigates the economic results of education. It attempts to answer the question, "Does the training an individual or group receives increase the value of post-training production by an amount at least as great as the cost of the training?"

During the fifties and sixties vocational educators began to talk seriously about accountability. By the early seventies several cost-benefit studies of vocational education programs had been completed. The rationale and procedures for conducting cost-benefit studies appeared regularly as convention topics (including the 1967 1968 AVA presentations by Jacob J. Kaufman and others). But today, we rarely see cost-benefit analysis applied to vocational education decision-making. Occasionally large scale projects are conducted to evaluate statewide efforts, and a few cost-benefit studies appear as doctoral dissertations. But local decision makers--superintendents and vocational directors--apparently do not often conduct this type of investigation.

The need for this project was based on the following assumptions:

1. The need for an interest in accountability in vocational education remains undiminished.[1]
2. Local decision makers have not utilized cost-benefit analysis in the past for two reasons:
   a. They have not really wanted the information, preferring to make decisions based on intuition and subjective judgment rather than gathering pertinent data and reaching decisions on an objective basis.
   b. If they had wanted the information, they could not obtain it because the current technology for cost-benefit analysis is too elaborate and sophisticated for the typical local administrator to comfortably use.
3. These two barriers can be overcome because:
   a. Local administrators are now becoming (either by preference or by pressure from above) more inclined to gather and use "hard" data for decision making.
   b. Procedures and techniques for cost-benefit analysis of local vocational education programs are now available.[2]

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[1] NOTE: At the 1976 CVA Convention meeting of the State Board for Community Colleges and Occupational Education several questions were raised with respect to the relative costs of various kinds of vocational programs. The state staff were unable to offer "hard" data to support their responses. The discussion which followed revealed an acute need for cost-benefit analysis and apparent frustration because this kind of information was not available. Now, in 1979, as this report is being prepared, the SBCCOE staff are meeting with consultants as they consider ways to incorporate cost-benefit analysis into the accountability system for vocational education in Colorado.

[2] NOTE: In a pilot test, six vocational directors, after an evening of orientation and training, used the procedure described in the attached document. All six completed an analysis of a local program and responded favorably to an evaluation of the material.

II. THE PROJECT

Objectives

Following are the objectives of the investigation as presented in the proposal to the Colorado Research Coordinating Unit for Vocational Education.

1. Demonstrate the feasibility of cost-benefit analysis as a source of information for local vocational administrators.
2. Document the use of cost-benefit information by local vocational administrators.
3. Evaluate the effectiveness of a workshop for training local vocational administrators to conduct cost-benefit analysis investigations.
4. Identify existing barriers and constraints that might prevent local vocational administrators from using cost-benefit analysis in program development and evaluation.

Now, as the final report for the project is being prepared, it is obvious that the first two objectives were originally stated as if the anticipated results were sure to follow. Actually the objectives turned out to be somewhat less optimistic. Rather than to "Demonstrate the feasibility of cost-benefit analysis as a source of information for local administrators" of vocational education, we evaluated or assessed that feasibility, as implied in the statement of objective four. Our assessment of the feasibility of cost-benefit analysis as a tool for local decision makers emerged from two perspectives. One, as expected, was in the evaluation of a specific cost-benefit analysis strategy and procedure,

as presented in the training materials. (See Appendix B.) The other, which was not addressed as an objective in the original proposal, was to assess some of the attitudes of a specific group of Colorado Vocational Administrators (not necessarily a representative sample). This attitude assessment was actually focused on one of the assumptions presented in the rationale for conducting this investigation--that "local administrators are now...more inclined to gather and use" cost-benefit analysis data (page 2, item 3-a).

Procedures

As the project unfolded we found that modifications in the procedure for the investigation became necessary. Some of the changes were simple matters of expediency; others were dictated by the revised project objectives.

Rather than present here the detailed list of tasks and procedures which were anticipated in the proposal, these are shown in Appendix C. Following is an outline of the tasks and procedures as the project was completed.

Task 1: Establish cooperative relationships and joint sponsorship of the project with representatives of the Colorado Council of Local Administrators (CCLA) and the State Board for Community Colleges and Occupational Education (SBCCOE).

Procedure: Copies of the funded proposal were distributed to selected individuals representing SBCCOE and CCLA, with an invitation to meet as a steering committee to plan an in-service training workshop and select participants. Twenty individuals were selected by the SBCCOE Regional Planners. Letters of invitation were mailed September 11, 1978.

Task 2: Conduct a six-hour workshop to train fifteen participants to conduct a cost-benefit analysis of a local vocational education program.

Procedure: A one-day training session was conducted on October 10, 1978, for the fourteen individuals who attended. Ten were vocational administrators and four were sent as representatives by their administrators.

Task 3: Conduct a survey to gather information from training program participants regarding their perceptions of the value and utility of cost-benefit analysis, and their perceptions of the specific procedures and materials used in the training session.

Procedure: It should be noted here that there were mixed--predominantly negative--reactions by participants, to the cost-benefit analysis procedure, and especially to the value of any such activity. (These reactions will be more fully discussed in the next section.) After consulting with the SBCCOE staff it was determined that a survey should be conducted. The survey instrument was developed by the principle investigator and reviewed by the SBCCOE staff. The survey materials (See Appendix A) were mailed February 6, 1979. Thirteen questionnaires were returned. Analysis consisted of tabulating the responses and calculating percentages.

Task 4: Conduct a literature search and prepare a state-of-the-art report on the utility of cost-benefit analysis as a tool for decision-making by vocational administrators at the local level.

Procedure: An on-line computer search was used to obtain abstracts of documents for review. The Lockheed Information Systems Computerized Literature Access Search Service (CLASS) was used to obtain 216 items for review. The keywords were cost-benefit, cost-effectiveness, and vocational education.

The review was delimited to those items which were apparently concerned with monetary costs and benefits of vocational education. Many cost-effectiveness studies, and investigations of other aspects of the economics of occupational programs were not included.

Findings and Results

Following is a brief description of findings and results of the program.

The training. Arrangements were made for conducting a six hour training program for selected local vocational program administrators. The plan was to familiarize the group with the cost-benefit analysis rationale and procedure outlined in the training materials (Appendix B). Then, using worksheets and a simple set of pre-prepared data, the group was to apply the procedure to a specific cost-benefit analysis problem.

During the initial workshop session a discussion of the utility and feasibility of cost-benefit analysis emerged and grew into a controversy among the participants. Two individuals were currently involved in SBCCOE funded project to develop a cost accounting system through which local vocational administrators were to determine (and report) "specific program and student costs with implications

for the development of an equitable formula for funding of post-secondary vocational programs." These individuals shared some of their experiences, with emphasis on problems in obtaining support and cooperation. When the morning session was completed, about half of the planned training had been accomplished. Extra time had been used in heated discussion about the difficulties to be encountered in obtaining program cost information, and about the political implications of doing so also, some participants had expressed their doubts concerning the value of cost-benefit analysis when only monetary benefits were to be considered. Because of the limited time available, only a superficial treatment of amortization of indirect costs over time and among programs, had been accomplished (See Appendix B, pages 9-16).

As the afternoon session began, it was apparent that not enough time had been provided for adequate coverage of the material on cost analysis. However, we proceded to consideration of the procedure for calculation of annual incomes a trainee could expect to earn during his or her working life (the "age-income profile"). (See Appendix B, pages 16-27.) It is not necessary for the learner to fully understand the material on cost analysis, as a basis for learning about the calculation of benefits. Accordingly, the participants apparently understood the theory and general procedure for calculating monetary benefits which accumulate over the lifetime of a worker. But again, as in the morning session, controversy developed. The focus of concern was the use of secondary data sources (in this instance, census information) to estimate the age-earnings pattern. The participants clearly expected something more

straightforward, with more credibility, for use in the earnings profile component of the cost-benefit analysis model. Some of the participants appeared to be frustrated because they were expected to (1) obtain and search through the 1970 census materials, then (2) use their personal judgment to select occupations which were assumed to relate to the training program, then (3) use "total income of males with income in 1969" to generate the age-earnings pattern representing the comparison group (with no training), then (4) use both income and earnings to generate the data representing the group with training, then (5) calculate adjustments so that 1969 figures could be used in 1978, and so on. This scenario may help the reader to understand how progress during the afternoon session eventually groun to a halt. A comment by one participant, on the follow-up questionnaire, seems to communicate the essence of the problem. He said that he "Expected a fast-paced informative workshop, . . . a (simple, easily understood) format and formula worked out and a sample program to plug in--easily adaptable to local programs."

The survey. A mail survey was used following the training workshop (Appendix A). One objective (part A) was to assess the attitudes of the participants regarding the importance and utility of several kinds of procedures which might be used in planning and evaluation of vocational education. This part of the survey was designed so that the cost benefit analysis which was the focus of the training session could be compared with other typical kinds of program evaluation.

Another objective of the survey (part B) was to allow the participants to evaluate the training they had received. Specifically, this part of the questionnaire was designed to reveal their attitudes about the focus of the training (Did they want and/or expect something else?), about the scope of the cost-benefit analysis (concerned only with monetary benefits), and about the complexity of the calculation procedures.

The following table shows a summary of the results of questionnaire part A.

TABLE I
IMPORTANCE OF VARIOUS RESEARCH PROCEDURES

Research Procedure	Considerable Importance		Limited Importance		No Importance	
	No.	%	No.	%	No.	%
Cost-benefit analysis concerned only with monetary benefits	3	33	5	56	1	11
Cost-benefit to reveal monetary, personal and social benefits	6	67	3	33	0	0
Cost-effectiveness to reveal monetary costs related to placement, etc.	8	89	1	11	0	0
Effectiveness evaluation to reveal results with no reference to costs	4	44	5	56	0	0
Process evaluations using quality indicators based on ideal model	2	22	6	67	1	11

Note: the above percentages are based on nine responses because three individuals did not respond to this part of the questionnaire.

From the information presented in Table I we see that two-thirds of the respondants consider a procedure designed to reveal only monetary costs and benefits as being of little of no use in their decision making. However, only one-third felt that way regarding

a procedure which would also include non-monetary costs and benefits such as job satisfaction. Two-thirds feel such a procedure would produce more than enough usable information to justify the time and cost of the research.

Reactions to evaluating program effectiveness or results in terms of the achievement of program objectives, were mixed. Only 44% rated this type of evaluation as being of considerable importance while 56% considered it to be of little benefit for their decision making.

It is interesting to note that the procedure which appeared to be least useful and important to this group of vocational administrators, is a quality evaluation procedure designed to reveal how well a program compares with an ideal. However, this is the type of evaluation which is currently most used in Colorado--the Comprehensive Program Review (C.P.R.). The C.P.R. involves the use of a team of experts who use such evaluative criteria as instructor qualifications, modern equipment, and the functioning of an advisory committee, to evaluate program quality.

The planning and evaluation research which is apparently considered to be of greatest importance and utility is the cost-effectiveness model. This procedure relates monetary costs to outcomes such as job placements and employer satisfaction with trainee performance. All but one of those responding (89%) indicated that procedure to be of considerable importance.

Questionnaire results for part B are shown in Table II. The purpose of this part of the survey was to determine opinions about the cost-benefit analysis model and materials used in this training session.

TABLE II
REACTIONS TO THE TRAINING CONTENT

Reaction		SA	A	N	D	SD	NR
Disappointed with training content and expected something else.	No	6	3	2	0	0	2
	%	46	23	7	0	0	7
Disappointed with analysis concerned only with monetary benefits.	No	0	1	4	3	1	4
	%	0	8	31	23	8	31
Considered calculation to be too complicated.	No	5	1	1	1	2	3
	%	38	8	8	8	7	23

Note: Reaction scale, from left to right, indicates strongly agree, agree but not strongly so, neutral or undecided, disagree but not strongly so, and strongly disagree with the statement, and no response. Note also, that there were 13 individuals in this group.

Two essentially negative reactions are shown on the above table. Nine of the thirteen participants (96%) indicated "disappointment with the training content and expected something else." The second negative reaction was that the calculations required in the training materials were too complicated.

On the other hand, only one person indicated disappointment because the analysis was concerned only with monetary benefits. Given the negative reaction to the importance and utility of such a procedure, as shown in Table I, it appears that the group generally anticipated, but were not particularly pleased with the focus of the training content.

The review of literature. The annotated references at the end of this section constitute the results of the literature search and review. The purpose of the review of literature was to gather information about the utility of cost-benefit analysis as a tool

for decision-making by local vocational administrators. This statement of purpose delimits the scope of our project and allows us to concentrate on the local level, on a single program focus, and on analysis models of a particular type--those concerned with monetary costs as inputs and economic benefits as outcomes. The following discussion is based on direct findings or apparent implications drawn from the findings of all three components of this project--the literature, the survey, and the training.

Discussion. The following three questions provide a framework for the discussion of problems and issues, and for presentation of the "state-of-the-art report" referred to in task 4 (page 5).

1. What kinds of research reports were found in the literature search?

Two hundred sixteen items were made available for review through the CLASS search. Forty-three were selected for review and annotation. We selected every item that in any way appeared in total or in any part, to be relevant to cost-benefit analysis of vocational programs.

The most significant discovery was that only three items were within the parameters established for this project--cost benefit investigations involving a single vocational program and/or small geographic area. This might be explained by the fact that such investigations are of value only at the local level, thus limiting the possibility of publication in the mainstream of vocational education research literature. However, we have two additional sources of evidence that small-scale local cost-benefit studies are not often being conducted. One is the fact that the literature does

not present workable models, procedures and techniques for such investigations; only for the more grandiose, large scope studies. The other is that whenever we have asked "the experts"[3] if they knew of any small-scale, local cost-benefit studies, the answer was always negative. The typical comment was in essence that such studies are just not feasible with current technology.

Eleven cost-benefit investigations involving a variety of programs and/or a large geographic area were found in the CLASS search. Including the three local projects, we find that fourteen, less than one-third, of the forty-three items selected for review, were reports of cost-benefit investigations.

Twenty-one items (about one-half) pertain to theory, model-building, and technology--explaining how to conduct cost-benefit or related studies. This kind of pattern is to be expected if you accept the assumption that applying cost-benefit analysis to the evaluation of education programs is a new and emerging concept. However, the model-building literature has been appearing for more than a decade. And, in the opinion of this observer, the basic models and supportive rationale were most eloquently presented at first. There appears to be no pattern of articulated development, with later work building on previous achievements. The more recent discourse appears only to repeat--often with less clarity-what others have said.

As might be expected when a substantial body of theoretical literature appears, we found eight (19%) of our forty-three items

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[3]After presentations at workshops and conventions, and in consulting relative to this project, at least a dozen people were questioned.

to be literature reviews and state-of-the-art reports concerned, at least in part, with cost-benefit analysis. Most of these were broad in scope, including several aspects of the economics of vocational education.

2. Is cost-benefit analysis feasible as a source of information for local vocational administrators?

Rather than firmly commit ourselves to a "yes" or "no" we will answer this question by saying "it all depends." We would say "no" if certain conditions are met. But if pushed to answer regarding whether or not those conditions are likely to be met, the answer would have to be a definite "no."

With that somewhat evasive introduction, let us outline the conditions that must be met if cost-benefit analysis is to be feasible at the local level.

(a) Calculating costs. If the programs relatively small and self-contained, cost calculatin is not too difficult. But the procedure of cost analysis becomes very complex and at the same time less reliable when these figures must be estimated as a small share of the costs of a major educational enterprise. For example, consider the task of unravelling the costs of a program for training small engine mechanics offered by one of several community colleges in a large urban system. Perhaps the instructional facilities and equipment are shared with other vocational and general education classes. Students receive instruction from several different teachers. Supplies and materials budgeting is centralized. It would be a considerable challenge for a cost accountant, much less a typical school administrator, to allocate all the various shared

costs to the various programs and courses. Then, if costs to the students (lost income while in training, education expenses, etc.) are included in the calculation, the problem is compounded. However, if system-wide cost analysis is undertaken by the central administration, or if the analyst is content with rough estimates (and less reliability) for the cost component of the model, usable cost information can be obtained.

(b) Calculating economic benefits. In the opinion of this observer, the benefits side of the analysis model presents the greatest barriers to implementation of cost benefit analysis at the local level. This is where the model-builders have failed to meet the practical needs of the researchers. Most theoretical models for cost benefit analysis include a component relating to the economic welfare of two types of people--the vocational program participants and a comparable group of non-participants. Always, one or more of the following defects are found in every model reviewed for this project. (We would be delighted to have this statement challenged, and to find that there is a system with none of the defects outlined below.)

(1) When economic benefits are to be assessed using a comparison of the lifetime earnings of the two groups (participants and non-participants), the actual, workable procedure for obtaining reliable, accurate earnings data for both groups in simply not provided in the model. The ideal kind of data would be derived from long range follow-up studies involving program graduates or others comparably trained. This kind of data simply does not exist, except for a

few very specific occupations. Also, there appears to be no possibility of finding or developing data for comparison groups who can be presumed to be identical to the program participants, but without training--for a lifetime. The cost and logistics that would be required to develop a data pool that local vocational administrators might use would probably overshadow the costs of all other vocational education research. Most model builders recognize this barrier, and suggest less desirable data to be used instead. This leads us into the second typical defect found in cost-benefit analysis models.

(2) When substitute (or surrogate) data is used to represent lifetime earnings for vocational program participants and non-participants, the procedure becomes too complex for typical vocational administrators to tolerate. This is not because they lack the scholarly abilities required. It is because they simply find it unacceptable to invest the intellectual energy and time. Also, this substitute data is usually so obviously unreliable that it tends to discredit the whole research effort. This is the model used for the training component of this project. We think it would be a good idea if all the model builders were required to face (as we did) the reality of training a group of practitioners to implement their models in realistic situations.

(3) When the cost-benefit model employs something other than long-run earnings to assess economic benefits. Whatever else is used appears to be flagrantly inaccurate as a benefit measure. Some typically used measures are wage rates. If a series of wage rates

is used, with estimates of future earnings projected on some rational basis, the accuracy of the analysis is tied to the accuracy of the estimated income. At best, this process opens the way for challenging the findings of the research. At worst, when only the job entry level wages of program participants is used, a basic tenet of vocational education is ignored. To illustrate this point, consider the Distributive Education program. If students enter retail sales positions during or at completion of the program, they do so in competition with untrained job applicants "off the street." No one expects the entry level D.E. student to earn more than an untrained person. The value of the training is assumed to be in the enhanced potential for future success--higher level selling skills, understanding of retailing principles and practices, and other competencies which are expected to produce faster advancement and increased earnings throughout the participant's career. But to use entry level earnings as an indicator of the economic benefits of a Distributive Education program would be absurd. Yet this procedure is advocated in some currently popular models (popular in that the authors have published and given speeches to large audiences). When we confronted one of these individuals (after a presentation at the American Educational Research Association) with the situation described above, he acknowleged our point. But he insisted that since a more appropriate benefits measure was not economically feasible, he was justified. We disagree. Our judgment is that it would be better not to conduct a cost-benefit analysis of a vocational program, than to conduct it using such an invalid measure of economic benefit. Probably most local vocational directors would also take that position.

(c) Identifying target occupations. We were unable to find any cost-benefit analysis models that satisfactorily addressed the problem of identifying the occupations for which training is being provided. Most authors were apparently unaware (or unconcerned) about this problem. And it is not a problem in some cases--cases most often used as illustrations by the authors. When the training program clearly focuses on a single occupation--cashier/checker, legal secretary, dental assistant, etc.--the identification of one or possibly several occupations (with D.O.T. descriptions available) is no problem. But a large majority of vocational education programs have no such direct, exclusive linkage with a specific occupational field. Consider, for example, programs in welding, cosmetology, food service, or secretarial training. A program graduate might be appropriately employed in many different industries, occupational levels, and kinds of jobs. This problem of program-occupation linkage is greatest in some of our most productive programs, with very general labels and only vague identification with occupational fields. These programs include high school Business and Office Education, Distributive Education, Vocational Agriculture and Vocational Home Economics. At the post-secondary level, "mid-management" Marketing, Data Processing, Drafting, and Electronics are examples. We seriously doubt that technology is currently available with which to conduct credible cost benefit analysis research on local programs with such wide scope and variety in their target occupations. The best alternative, in our opinion would be to select a representative sample of occupations in which former students are employed, develop a composite earnings profile and use it to represent the target

occupations for the program under study. Even so, this procedure is weak and open to criticism regarding the validity of the benefits measure.

3. May we expect in the future to see practical application of cost-benefit analysis at the local level?

This question should be answered in two parts. First, can it be used? That is, will innovative developments make it technically possible? Second, should cost-benefit analysis be used?

On the first question, it appears that if we really want to, we can pave the way for local vocational administrators to conduct cost-benefit research on their own, as they may choose. This is somewhat like saying that an electric automobile is available if we really want it. But first, we must pave the way for its development by inventing a practical, inexpensive fuel cell (to convert fuel to electricity). In our analogy, the critical missing component is the energy source. The corresponding missing component in cost-benefit analysis models is a practical, inexpensive source of valid information about future earnings of vocational program participants. If we want eventually to accomplished this, (whether we should want to is addressed in the next section), it is recommended that:

(a) Starting with program areas which appear to be of most concern, where we intend to take some action based on the findings of our investigations, we should develop a data bank or clearinghouse. Its purpose would be to coordinate development and dissemination of an assortment of age-income profiles for vocational program target occupations.

(b) Conduct a more intensive search for data--possibly using the mass of statistical information available through various government and industry sources--and develop a procedure for transforming that data into age-earning profiles that could be adapted for use with currently available cost-benefit analysis procedures (such as the one used in this project). It seems reasonable to assume that secondary data sources might be tapped to provide a practical, valid substitute for the hard, first-hand data referred to in the preceding paragraph. Again, a clearinghouse would be needed, and local administrators should not be expected to generate this data; only to obtain it on request (perhaps through computer access).

(c) Continue to work at the task of making accurate cost information available to local administrators. Again, as with benefit data, we should design and implement data access systems so that the local administrator would not be required to generate cost data for each program. Also, procedures and reporting portocols should be standardized, as Colorado is now attempting to do with post-secondary vocational programs.

(d) Through state or federal sponsored projects, conduct the research and development necessary to clearly define the target occupations that should be identified with each type of vocational program. Then, when the local administrator chooses to study a local program of a given type, the benefits data for the appropriate set of occupations could be plugged in. This procedure could be facilitated by placing data for many occupations in computer storage. Then the researcher could specify individual student career objectives and the

computer would print out a composite age-earnings profile for the vocational program.

The above recommendations should be implemented if cost-benefit analysis studies of vocational programs are to be conducted by local administrators. Obviously, to do so would require a substantial investment--one that might be more effectively used to facilitate other kinds of planning and evaluation research. Now, to conclude this report, we will comment on the second question with which this section is concerned--should cost-benefit analysis be used?

In our opinion, it would not be prudent to immediately launch a substantial effort to pave the way for conducting local cost-benefit research, as oulined above. Following are some of our reasons for taking this position.

(1) It appears that whether they need it or not, local administrators simply do not want cost-benefit analysis in their repertoire of planning and evaluation tools. They do not feel the pay-off in information is worth the effort to obtain it. If personal and social costs and benefits were included, that attitude might change. While a few of the models found in the literature search included analysis of non-economic costs and benefits, it is our opinion that valid, reliable measures and assessment techniques for this type of research simply do not exist. Furthermore, we see no hope of their development because of the huge investment this would require.

(2) While local vocational administrators are apparently not ready for cost-benefit analysis, they are obviously ready for something to expand and improve their planning and evaluation efforts. High on their list of expressed needs (as shown in this study) is

cost-effectiveness evaluation, for example. Rather than make specific recommendations about exactly what research tools should be made available to local administrators, we will attempt to show that there are many potentially feasible, potentially useful alternatives that should be considered.

To help the reader visualize the wide array of planning and evaluation data that might be used along with or instead of economic analysis data, we have included, as Appendix D, a list of thirty "vocational education outcome questions."[4] Questions 5, 21, and 30 pertain to the economic returns to students or society--the focus of this project. But many of the remaining 26 questions relate to planning and evaluation data that may be of equal or greater value to vocational administrators. As with cost-benefit analysis, there may be a substantial investment required to develop the technology and research by local administrators. But they appear to be willing and able to use data-based planning and evaluation. Obviously, they should use a greater variety of data than past paractice indicates. They will use it only if and when they can have confidence in the validity and reliability of the measures, assessment procedures, and input data provided for them.

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[4] This list of questions is found in a paper by Robert L. Darcy titled Vocational Education Outcomes: Perspective for Evaluation, Research and Development Series No. 163, The National Center for Research in Vocational Education, Columbus, Ohio, 1979.

According to Darcy[5] we have a long way to go before high credibility planning and evaluation research can be conducted. In conclusion, we recommend, as Darcy does, "...the formulation of a research, development, and evalution agenda, aimed at producing clear, accurate, relevant, credible, and communicable findings." Additional evaluation studies which repeat shortcomings of design and methodology (including those described in this report) which are currently prevalent will not meet local vocational administrators needs for planning and evaluation data.

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[5] Ibid. Page 38.

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LITERATURE REVIEWS AND STATE-OF-THE ART PAPERS ON COST BENEFIT ANALYSIS.

Kraft, Richard H. P. Cost Effectiveness Analysis of Vocational-Technical Education Program. ERIC Docment Reproduction Service, ED034055 VT009690, 1978.

This study was concerned with the collection and analysis of empirical data regarding the public and private costs and some utility aspects of vocational-technical education at two educational centers. Activities including establishing: (1) occupational objectives of programs offered, (2) the degree of attainment of occupational objectives by graduates in terms of earnings level, (3) a cost-effectiveness ratio, by dividing the private and public costs per student by a ranked utility number assigned to the earnings level of each sampled graduate and computing a mean ratio for each program, and (4) a simulation model with respect to optimizing a number interacting variables such as staff and facility organization and utilization. The study report is preceded by a literature review and discussions of cost-utility as an emerging concept, the cost-benefit role in Planning, Programming, and Budgeting Systems (PPBS), and cost-utility systems in school administration. A model for further analysis is presented following the study report.

Kotz, Arnold. Occupational Education--Planning and Programming. ERIC Document Reproduction Service, VT005042 ED017734, SEP67.

Additional position papers based on information gathered in the reconnaissance surveys of planning and programing in occupational education, reported in volume one (VT 005 041), are presented. Part IV, concerned with program structure and budgeting and their relation to the planning process, includes the papers--(1) "Current Policies and Practices," by Arnold Kotz, (2) "The Program Budget--its Value to Education at Federal, State, and Local levels," by Robert N. Grosse, (3) "Budgeting for Vocational-Technical Education," by Thomas G. Fox, and (4) "The Vocational Education Act of 1963--Intergovernmental Fiscal Relations," by Bruce F. Davie. Part V, an attempt to clarify the theoretical and methodological issues of an economic analysis of Vocational Education, includes (1)"Benefit Cost Analysis of Vocational Education--A Survey," by Bruce Davie, (2) "Economic Concepts and Criteria for Investment in Vocational Education," by Ernst Stromsdorfer, (3) "A Benefit-Cost Framework for Education," by Robert Spiegelman, (4) "A Summary Guide for Benefit Cost Analysis," by Einar Hardin, (5) "Manpower Demand and Supply," by Arnold Kotz, (6) "Evaluation of Supply-Demand Projection Concepts, and Techniques," by Thayne Robson, (7) "Forecasting Occupational Job Requirements," by Norman Medvin, (8) "Manpower Requirements to Meet National Goals in Research and Development," by Leonard A. Lecht, and (9) "Evaluation" and (10) "Organization for Planning," by Arnold Kotz. A 15-page "Checklist for School Evaluations," a bibliography of 111 references, and transcripts of several group discussions are included.

Law, Gordon F. Research Visibility. Vocational Education is Service--Leadership and Administration. ERIC Document Reproduction Service, ED018674 08 VT005473, 1978.

Nineteen reviews in this issue pertain to leadership and administration. One of the major areas of concern identified by the panel of consultants on vocational education. They are organized by topics--(1) "Leadership Training, Workshops, and Institutes" treats an interdisciplinary forum on occupational education, A Home Economics Workshop, A doctoral Program Symposium, and Six Leadership Development Meetings, (2) "Costs Differences, Cost-Benefit Analysis, and Costs and Returns of Technical Education. (3) "State Administration" describes Michigan's Leadership Program, instruments used in studying state agencies, and criteria for self-analysis for vocational education, and (4) "Studies of general interest to administrators" includes a post-war examination of vocational education and intergovernmental fiscal relations, social factors in slums, and implications of vocational education for company plant site selection. "Plain Talk," a continuing column, discusses leadership development efforts in vocational education and two of the reviewed studies. The bibliography lists eight related studies which are in process. This article is published in the "American Vocational Journal," Volume 43, Number 4, April 1968.

Stromsdorfer, Ernst W. Review and Synthesis of Cost-Effectiveness Studies of Vocational and Technical Education. ERIC Document Reproduction Service, VT014707 ED066554, 1972.

The methodology to perform benefit-cost studies exists, but there is much ambiguity concerning the implications of such studies as a result of using faulty methodology. For example, control groups are a necessity, as are adequate sampling procedures and adjustment for non-response bias and self-selection bias, and all studies do not employ this methodology. Another limitation is that currently a benefit-cost study will only show whether or not a program appears to pay. Further judgments must be made on whether to expand or cut back the program, and what to give up or take on. In spite of these and other limitations, benefit-cost analysis interjects a systematic analysis into a previously judgmental area. The cost and methodological limitations of such studies will inhibit their immediate widespread adoption. This study, written for non-economists, surveys the various approaches to improving the analysis of vocational education and related manpower training programs.

Wood, W. D., and Campbell, G. F. Cost-Benefit Analysis and the Economics of Investment in Human Resources. ERIC Document Reproduction service, VT012352 ED045848, 1970.

This annotated bibliography presents 389 citations of periodical articles, monographs, and books and represents a survey of the literature as related to the theory and application of cost-benefit analysis. Listings are arranged alphabetically in these eight sections: (1) Human Capital, (2) Theory and Application of Cost-benefit Analysis, (3) Theoretical Problems in Measuring Benefits and Costs, (4) Investment Criteria and the Social Discount Rate, (5) Schooling, (6) Training, Retraining and Mobility, (7) Health, and (8) Poverty and Social

Welfare. Individual entries include author, title, source information, "headings" of the various sections of the document which provide a brief indication of content, and an annotation. This bibliography has been designed to serve as an analytical reference for both the academic scholar and the policy-maker in this area.

Policy Issues and Analytical Problems in Evaluating Vocational Education. ERIC Document Reproduction Service, VT017227 ED068702, JUL72.

This second part of a final report delineating policy issues and analytical problems in evaluating vocational education. Includes three extensive appendixes and a wide range of tables. The appendixes include: (1) the methodology of cost-effectiveness analysis and a critique of the methodology of major studies, with illustrations, (2) selected statistics on the cost-benefits of vocational education at the secondary, post-secondary, and junior college levels from various sources, and (3) an annotated bibliography on the socio-economic background of students in vocational programs, changing enrollment patterns in vocational education, career opportunities, manpower projections, planning in vocational education, and finances and priorities in vocational education. The first part of this final report is available as VT 017 228 in this issue.

Policy Issues and Analytical Problems in Evaluating Vocational Education. ERIC Document Reproduction Service, VT017228 ED068703, JUL72.

This analysis of current and available information of the evaluation of vocational education and its policy implications includes a methodological appendix showing major studies of cost-effectiveness analysis and a critique of the various techniques employed in these studies, and an extensive bibliography of relevant source materials and related studies on vocational education. The present vocational education system is an umbrella for a wide variety of programs, which have as a common denominator their eligibility for Federal support through the different vocational education acts and amendments. These programs usually supply students with a marketable skill while providing them with a basic knowledge of the humanities, and may include training in homemaking skills and consumer education. On-the-job training, apprenticeships, community colleges, and other programs supplement vocational education curriculums offered in public schools. In fiscal 1970, only one sixth of the total government expenditures for vocational education represented Federal funds, showing that Federal support is too small a percentage of the total for the Federal government to be a primary change agent within vocational education. Part II of this report is available as VT 017 227 in this issue.

Review and Synthesis of Research on the Economics of Vocational Education. ERIC Document Reproduction Service, VT007438 ED023937, NOV68.

This publication is to introduce vocational educators and others interested in occupational education to research and writings on the economics of vocational-technical education. Research pertaining to cost-benefit and cost-effectiveness analysis of vocational education and manpower training programs is emphasized.

Major sections are devoted to a review of research and writing pertaining to the theory and concepts of the economics of education. The methodological and conceptual problems involved in evaluating vocational-technical education programs using cost-benefit and cost-effectiveness models, results of cost benefit and cost effectiveness studies of public school vocational technical programs and manpower training programs, and the use of follow-up studies as a means of evaluating vocational-technical education programs. Other sections deal with studies of costs and returns from investment in rural technical schools, investment effects of education in agriculture, and the relationship between vocational education and students' propensity to drop out of school. The author's conclusions and recommendations are included. Of the 100 sources cited, the oldest was published in 1962 and most were published since 1966.

THEORY, MODEL BUILDING, AND TECHNOLOGY FOR COST-BENEFIT ANALYSIS

Arora, Mehar. Information System for Societal Cost and Benefit Analysis of Vocational and Manpower Programs. ERIC Document Reproduction Service, ED124745 CE007361, 1978.

The study was directed toward developing a manual for establishing societal benefits and costs of vocational and manpower programs in Wisconsin. After first outlining the background of benefit-cost analysis, problems in establishing cost functions in education are presented along with some important cost concepts and uses of cost information in education. The next section deals with the identification and measurement of societal benefits of vocational programs. Five different methods of analyzing data related to societal costs and benefits of vocational and manpower programs are discussed in the last section. These methods are present value of net benefits, annual value of net benefits, rate of return, benefit-cost ratio, and pay back period. Procedural steps used and the advantages and disadvantages of each method are given. One of the major problems in establishing societal costs and benefits of vocational programs is the lack of relevant data, consequently, a need existing to develop a management information system for vocational, technical, and adult education. The report concludes that data required for the costs and benefits should be incorporated in a management information system. The required information for implementing various steps in establishing societal costs and benefits is outlined for curriculum, faculty, space, equipment, supplies, and administration.

Barsby, Steven L. The Application of Cost-Benefit Analysis in Manpower Area. ERIC Document Reproduction Service, VT 017569 ED069890, 1970.

The relative efficiency of various manpower programs as seen through cost-benefit analysis is assessed, and the contribution that cost-benefit analysis has made in evaluating manpower programs is discussed, taking into account a variety of methodologies presented in different studies. Vocational rehabilitation appears to yield the highest benefit-cost ratios, followed by programs involving on-the-job training, vocational education in vocational high schools,

out-of-school institutional retraining programs, post-secondary vocational education, job corps, and drop-out prevention programs. Comparisons of these activities are hindered by economists' failure to agree on a common methodology for conducting cost-benefit research, the existence of unmeasured benefits and costs, the absence of good cost data, and insufficient economic commitment. Deficiencies in cost-benefit analysis appear to be minimized when the analysis is directed at the internal operation of programs. It is in this direction that cost-benefit analysis particularly needs to be developed.

Barsby, Steven L. School Accounting Practices for Occupational Education: An Appraisal and Suggested Revisions for the State of Arizona. ERIC Document Reproduction Service, VT012885, MAR71.

As a basis for suggesting a statewide data system, this study presents a comparison of cost data on occupational education presently available at the district, county, and state levels. Such a system will have to (1) facilitate the information needs of the office or education, (2) be based on sound accounting principles, (3) be flexible to allow its use for cost-effectiveness and cost-benefit studies, and (4) comply with present statutes governing school accounting practices. A major finding of the study was that school administrators at all levels do not have sufficient information to facilitate sound policy and decision making. Thus, it is recommended that a pilot district be selected for initial development and testing of the suggested data-collecting system.

Davie, Bruce F. Using Benefit-Cost Analysis in Planning and Evaluating Vocational Education. ERIC Document Reproduction Service, VT003393 ED016077, NOV65.

Basic elements involved in analysis by rational resource allocation are applied to vocational education. To improve the efficiency of use of allocated resources, the relationships between application of resources to a particular program and attainment of objectives can be determined by benefit-cost analysis. The ratio of the present value of future benefits to the present value of future costs. Costs and benefits of particular vocational programs must be analyzed from the viewpoints of both the individual student and society. The derived ratios are the societal benefit-cost analysis treats benefits as an unknown in an equation including known cost, number of students, and an arbitrarily selected benefit-cost ratio. Some limitations of using benefit-cost analysis for evaluating vocational education and as a basis for making public expenditure decisions in the field are--(1) different people have different money values so that what is dollar value to one may not be to another, (2) the search for the best possible programs is limited to only those proposed, (3) it is difficult to assess the value of intangible benefits which cannot be measured in dollar terms, and (4) considering program value from only a local viewpoint may result in maintaining or rejecting one in conflict with the aggregate or national interest. Despite possible limitations, use of benefit-cost analysis appears desirable in evaluating and planning

vocational education at the state and local levels because it identifies current or proposed programs in which probable economic benefits do not justify the actual or prospective expenditures. The appendix contains a precise formulation of the benefit-cost analysis methods.

Ittner, Fred E. Project to Develop a Cost Benefit Model for Vocational Programs at College of Alameda. ERIC Document Reproduction Service, ED072774 JC730044, 1978.

A pilot study is reported in the development of a cost/benefit analysis model for vocational education programs in community colleges and its application to three programs at the College of Alameda. This model can be used to compare and assess the effectiveness of occupational education programs at the same college or different colleges at the same time or at different times. The model is based on the idea that program income derived from placements of students who have completed the program. It is a generic model that is flexible enough to allow users to develop specific models to suit the particular needs of a particular college or district. A model includes a selection of costs to be assessed and analyzed in terms of program costs and benefits to be derived. the model was applied to the business equipment technology, dental assisting, and diesel mechanics programs at the College of Alameda. Institutional direct and indirect costs were selected for analysis because the model's use was determined to be primarily for the allocations and reallocation of institutional resources. Benefits used were increased earnings to the student who completed the program and was placed in the field for which he was trained. Results indicated that the increased income on entering the field was quite small. Further follow-up studies should be conducted to determine the extent of salary increases, and students and faculty should be better informed of the starting salaries for various fields.

Kaufman, Jacob, and Cohn, Elchanan. Conceptual Issues in Cost-Impact (Benefit) Analysis. ERIC Document Reproduction Service, VT018809 ED072303, SEP72.

As a response to several specific economic analysis questions asked by the staff of Massachusetts' Management and Information System for Occupational Education (MISOE), this paper focuses on concepts of costs and benefits required for cost-effectiveness analysis. Useful as background material for those unfamiliar with economics, this paper intends to clear up misconceptions surrounding cost-benefit analysis by a simple presentation of various conceptual issues. Topics covered include capital costs, average and marginal cost, cost sharing, and cost functions. Related Documents are available in this issue as VT 018 600, VT 018 602, VT 018 606, and VT 018 810.

Kaufman, Jacob, J. Cost-Effectiveness Analysis as a Method for the Evaluation of Vocational and Technical Education. ERIC Document Reproduction Service, VT008586 ED029983, DEC68.

It is the purpose of this paper to discuss cost-benefit analysis in terms of: (1) its logic and meaning, (2) some of the misconceptions which prevail concerning this method of evaluation. (3) some of the problems and limitations of this method, and (4) the conclusions of a study which attempted to determine whether or not these is pay-off an investment in vocational and technical education. Cost-effectiveness analysis is an attempt to establish the equivalent of a system of market principles for various types of government activities. One should not talk about education in terms of cost or needs alone. No cost can be justified without a reference to pay-off, and the satisfaction of any need cannot be justified without reference to cost. Cost-benefit analysis forces andministrators to think through their objectives, concentrate on cost, and think in terms of alternatives. Some misconceptions are: (1) it seeks to conduct education on a least-cost basis, (2) benefits are measured only in dollar terms, (3) some things are not quanitifiable, (4) the technique has not been fully developed, and (5) it tends to ignore political considerations. A Pennsylvania study was reported which revealed certain values of vocational-technical programs over other high school curriculums.

Kim, Jin Eun. A Cost-Effectiveness Analysis Model for Evaluating and Planning Secondary Vocational Programs. ERIC Document Reproduction Service, EJ177613 EA509693, 1978.

This paper conceptualizes a cost-effectiveness analysis and describes a cost-effectiveness analysis model for secondary vocational programs. It generates three kinds of cost-effectiveness measures: program effectiveness, cost efficiency, and cost-effectiveness and/or performance ratio.

Kim, Jin Eun. Cost-Effectiveness Measures for Evaluating Secondary Vocational Programs. Eric Document Reproduction Service, EJ164165 EA508814, 1978.

This paper provides cost-effectiveness measures that can be used for analyzing secondary vocational programs in terms of program effectiveness against cost-efficiency.

Kim, Jin Eun. A Cost-Effectiveness/Benefit Analysis Model for Post-Secondary Vocational Programs. ERIC Document Reproduction Service, ED151560 CE015144, 1978.

A cost-effectiveness/benefit analysis is defined as a technique for measuring the outputs of existing and new programs in relation to their specified program objectives, against the cost of those programs. In terms of its specific use, the technique is conceptualized as a systems analysis method, an evaluation method, and a planning tool for vocational programs. To illustrate an educational systems model, three types of post-secondary vocational instututes in Indiana are identified and examined in terms of their inputs, outputs, and operations. Additionally, the three facets of vocational program classification, time frame, and evaluation criteria are integrated in a tri-dimensional structure for evaluating post-secondary vocational education programs. A model is then presented of a system existing within a social framework, illustrating three kinds of cost-effectiveness/benefit measures it generates: (1) program

effectiveness measures; (2) cost efficiency measures; and (3) cost effectiveness and performance ratios. Fifteen formulas are specified to compute these measures in evaluating post-secondary occupational programs. Data forms for determining program objectives, outputs, and costs, various computation tables, and a standard procedure for using the model are provided. (An administrator's manual for application of the model is available separately.)

Kim, Jin Eun. Cost-Effectiveness/Benefit Analysis of Post-Secondary Vocational Programs. ERIC Document Reproduction Service, ED151559 CE015143, 1978.

This manual is basically designed as a self-instructional guide by which post-secondary vocational administrators and educators can conduct cost-effectiveness/benefit studies. (Cost-effectiveness/benefit analysis is an evaluation technique which can be used for assessing outcomes of existing and/or new programs in relation to their specified program objectives and against their program costs, and can be used as a systems analysis technique, evaluation method, and planning tool for vocational programs.) The manual summarizes the cost-effectiveness/benefit model for post-secondary vocational programs, and it provides guidelines for conducting cost-effectiveness/benefit analyses by following step-by-step procedures in the planning, implementing, and utilizing phases. A set of program objectives and target goal statements, a data form for determining target goals and outputs, a program cost analysis form, and tables for computing cost-benefit measures are appended. (The complete model, forms, and procedures for using the model are also published in a separate technical report.)

Kotz, Arnold. Occupational Education-Planning and Programming. ERIC Document Reproduction Service, ED017733 VT005041, 1978.

Recommendations, conclusions, and position papers based on the results of a diagnostic survey conducted six states and 11 communities are reported. They concern: (1) identification of the objectives and goals of occupational education; (2) structuring of alternative programs to achieve them; (3) cost-benefit analysis; and, (4) projections of manpower supply and demand. With the survey findings and the position papers as background, an interdisciplinary conference was held at Airlie with 38 participants including economists, vocational educators, university and research personnel, administrators, systems analysis, and planners to determine the problems associated with planning and programing vocational education. Part I of the report includes: "Major Recommendations and Conclusions," by Arnold Kotz. Part II is concerned with how objectives and goals are determined by states and communities. Objectives identified in the diagnostic survey are discussed. Position papers are: "Objectives and Goals of Occupational Education," by Grant Venn; (2) "Evaluating Vocational Education-Problems and Priorities," Garth Mangum; and (3) "Problems of Application of the Program Planning and Budgeting System to Education," by Charles Hitch. Part III, concerning alternative programs to achieve occupational education objectives, includes the papers.--(1) An Educational System for the Seventies," by David Bushnell and Robert Morgan; (2) "An Industrial Approach

for Vocational and Technical Education--A State Directors Perspective," by Robert Worthington; transcripts of discussions following some speeches. A budgeting approach and a bibliography of 111 references used in the project are included. Additional papers are included in Volume Two (VT 005 642).

Manigum, Garth L. Contributions and Costs of Manpower Development and Training. Policy Papers in Human Resources and Industrial Relations No. 5. ERIC Document Reproduction Service, VT00465 ED021949, DEC67.

As a part of a larger project under grant from the Ford Foundation to evaluate federal manpower policies and programs, this evaluation of the training efforts under title II of the Manpower Development and Training Act (MDTA) made use of data provided by the Departments of Labor, and Health, Education, and Welfare. By the end of fiscal 1967, 1.2 billion dollars had been obligated for training the unemployed and underemployed under Title II of the Act. As the combined result of original congressional intent and subsequent experience, MDTA induced programs have come to have six potential and identifiable objectives: (1) facilitating employment of the unemployed, (2) reducing poverty, (3) lessening inflationary pressures, (4) meeting labor shortages, (5) upgrading the labor force, and (6) revamping traditional institutions. On the basis of a detailed analysis of both quantifiable and nonquantifiable accomplishments, the extent to which each objective has been achieved is examined and and estimates of the overall costs of the program are made before turning to a review of cost-benefit studies for comparison with previous conclusions. The results of the appraisal are clearly favorable. In general, every current component may not pay, but the overall contributions of the program have exceeded its costs by a margin which not only merits support but justifies expansion.

Marson, Arthur A., and Others. Cost Benefit Model Development. ERIC Document Reproduction Service, ED146435 CE013643, 1978.

A one-year cost benefit analysis study was conducted by a consortium of technical institutes, and two cost benefit models were developed and refined for evaluating benefits and costs of full-time vocational technical programs and aidable, noncredit adult education courses. The models were tested on a sample of nine full-time vocational technical programs and sixty-three adult education courses which reflected a cross-section of instructional areas in vocational technical education. Findings were that benefits from vocational technical education programs and aidable, noncredit education courses outweigh the costs of such courses for both the student and for society and 2.17 to 1.00 for an individual student. Six recommendations were offered and included further research being done on the noneconomic costs and benefits of vocational technical education. (Results of the test programs are presented in this report, as well as the models. Correspondence and sample cost benefit and survey forms are appended.)

Oliver, J. Dale, and Others. Vocational Education Evaluation Project. ERIC Document Reproduction Service, VT016156 ED065699, APR72.

Designed to aid decision-makers at the state and local levels, the Vocational Education Evaluation Project (VEEP) will: (1) Develop a planning system which will include a computer-assisted system for gathering data on vocational education in Virginia. (2) Develop a system to upgrade planning and evaluation in the classroom, (3) identify process and product variables and collect and analyze information on the effect of process variables on the product variables, and (4) develop a cost-effectiveness index which would supply information on the effectiveness of a vocational program for the resources expended on the program. At the state level, the management system will supply base data for planning and budgeting through a systematic procedure to collect, process, and reduce data. Information for a local administrators will be made available by means of program effectiveness component, a process-product component, and a cost effectiveness component. This project is scheduled to run through 1975.

Reinhart, Bruce, and Blomgren, Glen H. Cost Benefit Analysis--Trade and Technical Education. ERIC Document Reproduction Service, ED034056 VT009691, 1978.

This report contains introductory material on cost-benefit analysis, reviews of cost benefit studies by Andrew J. Corazzini and by Jacob J. Kaufman and others, a discussion of the basic concepts of cost-benefit analysis, and a discussion of two possible approaches to cost-benefit analysis of vocational education: (1) vocational versus academic education, and (2) vocational versus vocational education, which includes on-the-job training costs for graduates of the various curriculums. The report concludes: (1) the typical study thus far has been limited in scope; an implicit problem has been that of comparing different means as alternate means to the same ends, (2) the vocational versus vocational education approach would render unlike curriculums comparable, and (3) cost-benefit analysis is a useful decisional tool for allocating funds, but it assesses only the economic efficiency of a program. A plan for a possible cost-benefit analysis study of vocational education is presented in the appendix.

Sewell, Susan. Conceptual Framework for Conducting Cost-Benefit Studies in Wisconsin Vocational, Technical and Adult Education. ERIC Document Reproduction Service, VT101380, AUG74.

As this final report states, research was conducted to develop a conceptual framework and recommendations for conducting cost-benefit analysis studies of post-secondary vocational, technical, and adult education in Wisconsin. Sixty-four cost-benefit studies in different areas of vocational-technical education were reviewed. From the research, the categories of variables of cost-benefit studies that were identified include private and social, economic and non-economic, costs and benefits in all possible combinations. Also found in the studies were factors that influence cost-benefit studies, investigation techniques, and common problems of cost-benefit studies. The report concluded indicating that the research findings should

serve as a guide for conducting cost-benefit studies in Wisconsin vocational, technical, and adult education. A bibliography is provided.

Soong, Robert K., and Others. Cost-Benefit Considerations of New Careers Programs. Career Options Research and Development. ERIC Document Reproduction Service, VT014531 ED058440, SEP71.

Since the early 1960's, new programs have been developed to prepare poor people for jobs in hospitals, schools, social agencies, and community centers offering human services. To ascertain the cost effectiveness of these programs the Career Options Research and Development (CORD) project focused on the need for cost and benefit studies that recognize both quantifiable and non-quantifiable variables. It is noted that while ways can be found to average out specific variables, it is not yet possible to measure the variance in relationships between and among variables. Also, discussed in terms of cost-benefit analysis are the investment model, the human capital model, and the allocation of resources model. Further areas for research studies are suggested in order to answer questions such as: under what conditions and in what fields will horizontal mobility have more pay-off than vertical mobility?

Starr, Harold, and Others. Speeches Presented at the Annual Vocational Convention of the American Vocational Association. ERIC Document Reproduction Service, VT008213, DEC68.

Speeches presented were: (1) "A Model for Continuous Evaluation of Vocational Programs by State Departments of Education," by Harold Starr, describing a project of The Center for Vocational and technical education at the Ohio State University to develop evaluative criteria, (2) "Cost Effectiveness Analysis as a Method for the Evaluation of Vocational and Technical Education," by Jacob Kaufman, containing the logic and meaning of cost benefit analysis, misconceptions of cost benefit analysis, the meaning of evaluation, resistance to evaluation, and objectives of cost effectiveness study, (3) "Research Policy: Should it be Determined by State Directors or by the Bureau of Research? A Position," by Joseph Impellitteri, proposing a twofold approach to research including study based upon immediate solutions to practical problems of the practitioner and a focus upon the understanding of the underlying principles and theories upon which this complex is based, and (4) "Exploration with a Computer-Assisted Occupational Information System," by Joseph Impellitteri, containing a description of a Pennsylvania project to provide occupational information to students utilizing a computer-assisted career exploration system.

Warmbrod, Robert J., and Others. Speeches Presented at the Annual Vocational Convention of the American Vocational Association. ERIC Document Reproduction Service, VT008218, DEC68.

Speeches presented at the board meeting of the American Vocational Association's annual convention included: (1) "Economics of Vocational Education," by J. Robert Warmbrod, containing some quotes about the economics of vocational education, board members' concerns about the economics of vocational education, economics of education, benefit and cost of vocational education, determining

the cost of vocational education, reports of research, and some conclusions, and (2) "Vocational-Technical Education: A Partner in Economic Development," by William H. Seals, containing a description of the South Carolina Vocational-Technical Program.

Wilson, James A., and Wihry, David F. Investment Planning in Vocational-Technical Education. ERIC Document Reproduction Services, VT013728 ED055162, APR71.

To improve long-range vocational education planning in Maine. This study examined and evaluated the feasibility of replacing the manpower approach to planning with an investment approach. A survey of machinists was conducted to develop an instrument for measuring program benefits as part of the investment approach to program evaluation and planning. The investment approach proved to be valuable both in long-range planning and as an "in-house" planning and evaluation procedure for on-going programs.

Young, Robert C., and Others. Vocational Educational Education Planning: Manpower, Priorities, and Dollars. ERIC Document Reproduction Service, VT014880 ED062515, 1972.

This report considers the role of manpower information in vocational education planning. Following a review of the manpower and education contexts of vocational education planning, the report examines the concepts of manpower supply and demand and the sources of relevant information and methodologies for their estimation, considers criteria for determining vocational priorities, and describes a method for allocating resources among vocational programs. From a review of alternative manpower educational planning models, including manpower, rate-of-return, and social demand approaches, elements were selected which were feasible for a modestly inexpensive planning system. The proposed system acknowledges the existence of more complex planning models, discusses the data inadequacies and costs preventing their complete implementation, and suggests a methodology feasible in terms of existing or relatively inexpensive data and methodologies.

Field Test Results of the MISOE Management Information System for Occupational Education Program Cost Accounting System for Occupational Programs. ERIC Document Reproduction Service, ED115866 CE005704, 1978.

The document reports a pilot test of the feasibility of the MISOE Census Data System (CDS) for estimating the costs of individual programs in a regional vocational school setting. The test determined that the data collection forms can be completed by a regional vocational school but that they can be simplified, and the costs of individual programs can be determined from the data collected. As the system is structured to be applicable to all schools offering occupational programs, this determination implies that per-pupil costs for individual programs would be available to school managers within-school analysis and between-schools comparisons, and, used with program evaluation data, would provide a basis for cost-benefit and cost-effectiveness studies to be conducted on an operational scale. The balance of the report is directed to describing the mechanics of estimating the costs of individual occupational programs

in a typical regional vocational school and is supplemented with general discussions of analysis of program costs and implementation alternatives. Fifteen pages of tables are appended.

Speeches Presented at Annual Vocational Vocational Convention, American Vocational Association, Evaluation (61st, Cleveland, December 5, 1967). ERIC Document Reproduction Service, VT005078, 1978.

The document contains three complete speeches and summaries of two presentations and reactions to them. "The Role of Cost-Benefit Analysis in the Evaluation of Vocational and Technical Education," by J. J. Kaufman. Explains cost-benefit analysis in terms of its logic and meaning, some misconceptions. Problems and limitations, and the conclusions of a study by the Institute for Research on Human Resources at the Pennsylvaina State University. J. P. Hudson appeals for a maximum effort to provide vocational-technical training at post-secondary levels to meet changing conditions. Summaries of two presentations on the topic, "Merits of the Essential Principles of Cooperative Part-Time Education Programs" discuss related instruction, the role of the vocational teacher, the training station, the training plan, and the responsibilities of the coordinator. The reactions to these presentations by a high school principal and an industry representative are summarized. "Evaluation of On-the-job Training," by E. J. Burgess, discusses forms of evaluation such as the training plan, the progress report, tests, follow-up surveys, program reviews and evaluations, and documented statements from businessmen, students and parents.

COST-BENEFIT INVESTIGATION INVOLVING A VARIETY OF VOCATIONAL PROGRAMS AND/OR A LARGE GEOGRAPHIC AREA.

De Vore, Jack B., and Scott, Robert E. A Societal Cost/Benefit Analysis Model. ERIC Document Reproduction Service, EJ097466 CE501065, 1978.

A cost/benefit study of fourteen area vocational technical schools in Kansas was conducted to assess payback periods and analysis model devised for this study. The majority of programs studied were economically successful but were highly succeptible to placement rates.

Gallaway, Lowell E., and Ghazalah, Ismail. The Role of Vocational Education in Improving Skills and Earning Capacity in the State of Ohio: A Cost-Benefit Study. ERIC Document Reproduction Service, VT016378 ED067448, 1978.

The purpose of this study was to evaluate vocational education at the senior high school level in terms of both private and social costs and returns. Data on costs of vocational training and potential earnings with and without vocational training were used to estimate rates of returns on vocational education. Findings of the study indicate that all but one of the 14 vocational programs studied result in benefits--increase in earnings--that exceed costs. The study also indicated how worthwhile these various programs are from a private and social point of view. It points out and attempts to explain inter-program and inter-school differences in rates of return and points to the existence of economics of scale in this provision of vocational education.

Ghazalah, I. A. Vocational Education Planning Districts in Ohio. An Economic Evaluation of Foregone Benefits from Limited Participation. ERIC Document Reproduction Service, VT102183, FEB75.

This study addresses itself to the evaluation of the net social benefits from participation in vocational education at the senior high school level in the state of Ohio. Viewed as an investment in human capital, vocational programs were evaluated in order to estimate the excess of social benefits over social costs that accrue from training an individual in any of the programs offered. Benefits were measured in terms of contributions to the value of goods and services produced in the economy over the individual's working lifetime as a result of completing a vocational program; costs, in terms of the value of the goods and services that had to be given up in order to provide the training. The results for the sample vocational education planning districts were then used to obtain similar estimates for the state's remaining 103 vocational education planning districts. The computed estimates indicate that increasing the participation rate by senior high school students in vocational education programs to 40 per cent of average daily membership in all of the vocational education planning districts would result in a state-wide increase in net social benefits amounting to a minimum of $108,918,528 and a maximum of $326,951,424.

Gazalah, Ismail A. Vocational Education Planning Districts in Ohio: An Economic Evaluation of Foregone Benefits from Limited Participation. ERIC Document Reproduction Service, VT100791, 1978.

This study sought data on the costs and benefits of participation in Ohio's vocational education planning districts. Detailed data on school and program enrollments, costs, and earnings, were used to make the necessary estimates for a sample of four vocational education planning districts in Ohio and the state as a whole. The following three objectives were reached: (1) an estimate, on the basis of data from the sample districts, of the total social benefits from the programs to be projected for the state as a whole, (2) from each of the sample districts, an estimate of the net benefits based on current participations, and (3) an estimate of the potential net benefits to be attained by increasing participation to over 40 per cent of the average daily membership at the senior high school level in each district. Tables provide the data of the study.

Harris, Marshall A. Statewide Evaluation of Vocational-Technical Education in Florida. ERIC Document Reproduction Service, VT019461 ED074223, 1978.

This statewide study achieved the following objectives: (1) it developed a methodology for conducting a benefit-cost analysis of vocational education programs in Florida, (2) it examined, compared and analyzed public and private costs and benefits of four Florida vocational programs, (3) it compared public and private benefits and costs for students enrolled in day high school with students not enrolled in day high school, and (4) it yielded mathematical formulas that resulted in the development of a model for predicting public and private economic returns of vocational programs. Current program cost data were incorporated with data collected by means of student

follow-up questionnaires. Positive and significant rates of return were realized from public and student investment in each of the four selected vocational programs, with investments being recouped in less than two years, of the four programs, only the air conditioning program showed statistically significant differences in rates of return on investments. Vocational students had higher rates of return than regular secondary students although vocational student costs were greater. The methodology and the benefit-cost planning model proved effective and could prove useful in allocating resources to maximize public and student benefits. Development of vocational programs in Florida, especially in air conditioning, is recommended. Related documents in this issue are VT 019 460 and VT 019 462-VT 019 464.

Hu Teh-Wei, and Others. A Cost-Effectiveness Study of Vocational Education. ERIC Document Reproduction Service, VT007453 ED029093, OCT68.

This study was concerned with the optimum allocation of public resources in education, and involved a comparison between vocational-technical education and an alternative curriculum for non-college attending students. Major steps in the study were: (1) identification of costs and benefits, (2) collection of representative data, (3) determination of appropriate criteria for investment decisions, (4) statistical analysis, (5) calculation of the return to the investment, and (6) consideration of limitations and related issues. Data were collected in three cities. The dependent variables were the the average monthly earnings before and after taxes one and six-years after graduation, and the per cent of time employed one and six-years after graduation, The independent variables were (1) city of graduation, (2) type of curriculum, (3) sex, (4) IQ, (5) race, (6) marital status, and (7) father's education. Other non-monetary and non-economic benefits and performance characteristics such as voting behavior and economic aspirations were also examined. A detailed discussion of conceptual, statistical, and methodological considerations is included. It addition to an extensive discussion of specific findings.

Kaufman, Jacob J., and Lewis, Morgan V. The Potential of Vocational Education: Observations and Conclusions Based on a Study of Three Selected Cities in Pennsylvania. ERIC Document Reproduction Service, ED023902 VT007173, 1978.

An in-depth study was conducted in three selected cities to determine recommendations for improvement of vocational education. Some findings were: (1) most students entered the world of work without specialized occupational training, (2) enrollment in vocational programs was higher when students were taught in comprehensive schools, (3) an imbalance existed between high school enrollments in vocational programs and local labor market composition, (4) vocational education in the smaller cities was altered more closely to the areas of the labor market, (5) the majority of the graduates did not recall being reached by counselors, (6) vocational graduates had greater employment stability, received more rapid increases in earnings, and received higher averaged monthly earnings, (7) extra earnings of the vocational graduates justified the cost of their education, and (8) less than one-half of the male graduates obtained jobs that were directly

related to their training. It was recommended that: (1) programs in broad general skills with general applications be developed, (2) programs be aimed at the large proportion of students who see little relevance in either vocational or academic curriculums, (3) vocational education bring meanings and interest to the learning experience, (4) opportunity be provided for employment exploration and familiarization as an integral part of the curriculum, and (5) vocational guidance be expanded.

McNelly, D. E., and Kazanas, H. C. A Cost/Benefit Comparison of Cooperative Vocational and In-School Vocational-Technical Education Programs. ERIC Document Reproduction Service, EJ127297 CE504074, 1978.

The study compared graduates of cooperative vocational education programs and graduates of in-school vocational-technical education programs in 12 Missouri secondary schools to determine their annual earnings differences, the benefit/cost ratios of the programs, and the relationship of selected socio-demographic variables to earnings. Cooperative education was economically more efficient.

Schriver, William R., and Bowlby, Roger L. The Effects of Vocational Training on Labor Force Experience. An Analysis of the Tennessee Area Vocational Technical School System. ERIC Document Reproduction Service, VT013017 ED051388, FEB71.

To analyze the differential benefits from vocational training, a study was made involving 1,701 former students selected at random for 19 area vocational-technical schools in Tennessee. Major objectives of the study were to determine: (1) economic justification of vocational training, (2) wage differences among the vocationally trained and non-trained, and (3) internal rates of return to area vocational-technical schools. The data collected from high school records and responses of students to a mail questionnaire were put in tabular form for analysis. Some of the findings included: (1) vocational training increased labor force participation, reduced unemployment, and increased occupational mobility, (2) students with the lowest educational ability received the greatest rate of return, (3) vocational training was beneficial regardless of educational attainment, and (4) total public rate of return on investments in vocational training was 6.3 per cent while the private rate of return was 13.4 per cent. An example of a data form, questionnaire, follow-up letters, follow-up cards and records of the public cost of Tennessee Area Vocational-Technical School Program are appended.

Swanson, Austin D. A Study of the Costs, Benefits, and Effectiveness of Occupational Education. ERIC Document Reproduction Service, ED120523 CE006831, 1978.

The eight-year longitudinal study was conducted by the Board of Cooperative Educational Services (BOCES) district, Buffalo, New York to determine the costs, benefits, and effectiveness of vocational education in that region. The study consisted of three phases plus a comparison with academic programs in the district. The phases included: (1) program cost analysis based on program costs and expenditures, (2) collection of effectiveness and control data through a survey of graduates from BOCES and regular high school

programs, and (3) cost/benfit and cost/effectiveness analyses based on the ratio of benefits in dollars to costs in dollars. The findings included supporting tables and figures. Major conclusions are: (1) for cost analysis, comparisons, between the costs per pupil and the enrollment of occupation courses showed that a wide range of program costs existed within the BOCES schools; (2) for cost benefit analysis, considerable differences existed in the employment patterns of terminal students who selected BOCES occupational programs and those who did not; and (3) for cost effectiveness, higher programs costs were not rewarded with economic gains and a set of strategies to increase cost effectiveness is presented. A bibliography is included and the School Record Form and Alumni Survey Form are appended.

Wolman, Jean M., and Others. A Comparative Study of Proprietary and Non-Proprietary Vocational Training Programs. ERIC Document Reproduction Service, ED067523 AA001054, 1978.

Results of a survey undertaken to provide data about proprietary schools, their students, and their programs are presented. All proprietary schools in four metropolitan areas of the United States which trained students in four selected occupational areas were surveyed. Included for comparison purposes were non-proprietary schools offering comparable vocational training in the same geographical areas. This report contains the results of these surveys and focuses particularly on the following: (1) a comparative description of proprietary and non-proprietary schools, students, and alumni; (2) analysis and discussion of alternate measures of training effectiveness including placement, cost-benefit, and non-monetary measures; (3) discussion of such bodies; and the incentives to which proprietary schools respond in making these changes; and (4) conclusions and recommendations regarding evaluation, government funding and dissemination of information regarding vocational education. (For related document, see AA 001 055).

COST-BENEFIT INVESTIGATIONS INVOLVING A SINGLE VOCATIONAL PROGRAM AND/OR A SMALL GEOGRAPHIC AREA.

Schriver, William R., and Bowlby, Roger L. An Analysis of Differential from Vocational Training. ERIC Document Reproduction Service, VT013482 ED052358, APR71.

The objectives of this study were to find out how the characteristics of students and their training affect the rate of return in investment in vocational training, how they affect the earnings of trainees, and how vocational training influences the distribution of income among educational groups. The data were collected in a previous study and consisted of detailed records for 127 vocationally trained subjects and 127 individually matched untrained subjects. Records for 411 vocationally trained subjects were used for the analysis of earnings. The data were analyzed by analysis of covariance and multiple regression analysis. One strong relationship uncovered was the negative association between I.Q. and benefit from vocational training. Some conditions among former vocational

students that were found to be related to relatively higher income potential were: (1) study in health occupations, (2) being of the male sex, (3) working at a job requiring specific training, and (4) being a high school graduate. It was found that training led to similar proportionate income gains among the educationally deprived as well as high school graduates.

Sewell, Susan. Descriptive Cost-Benefit Studies of Selected Wisconsin VTAE Programs. ERIC Document Reproduction Service, ED118187 JC760113, 1978.

A cost-benefit study of vocational-technical education was conducted at Southwest Wisconsin Vocational-Technical Institute in 1974. Thirty surveys were mailed to students who had graduated in May 1973 from the account clerk program or the business administration-accounting program at Southwest Tech. Thirty-one surveys were mailed to those who had applied to attend Southwest Tech during the 1973-74 school year, but did not attend. Response rates were 63 percent for the graduate survey and 41.9 per cent for the nonattendant survey. The private economic variable studied was income after graduation. The private economic cost variables were books and supplies, and room and board, fees, transportation, and foregone earnings. The private noneconomic cost and benefit variables were satisfaction with the community, convenience, and attitudes toward education, present job, and making a decision as to a lifetime occupation. Costs are calculated and shown in tables; the average payback periods were found to be 6.97 years and 5.6 years. Since graduates have higher employment, higher earnings, and are more satisfied with their jobs and community, vocational-technical education would seem to be a worthwhile investment. The survey instruments are appended, and data are tabulated throughout the report.

Weiner, Arthur, and Marson, Arthur A. Cost Benefit Studies. ERIC Document Reproduction Service, ED122889 JC760275, 1978.

This document applies Dr. Mehar Aurora's method for conducting cost benefit studies to the Food Manufacturing Technology Dairy and the Food Manufacturing Technology-Canning and Freezing programs offered by the Moraine Park Technical Institute. Cost to individual students enrolled in the programs include tuition, fees, housing, travel, books, supplies, and foregone earnings while attending school, employability, and being a better consumer. For society, costs include capital and operational costs of the school, loss of tax revenues, and the foregone productivity of the laborer; benefits to society include additional tax revenues in the long-range, lower unemployment rate, less public assistance and welfare payments, and increased productivity of the workers. This study considers specific figures applicable to the dairy, and canning and freezing programs, and is intended to serve as a model for future studies in the costs and benefits of vocational-technical education. An outline of the basic methodology is included, as are charts resulting from applying the methodology to program statistics.

APPENDIX A

Survey Materials

Department of Vocational Education

Colorado State University
Fort Collins, Colorado
80523

February 6, 1979

Dear Mr.

The enclosed questionnaire is to follow-up the cost-benefit analysis training program in which you participated. You will recall that one purpose of the training was to evaluate a specific cost-benefit analysis procedure and the instructional materials which you received at that time. The response of the group during the training session indicated that there are problems with the analysis procedure or the training materials, or both. Now we are asking for your candid reactions to help us identify the specific problem areas.

In addition, we are asking for information to assess your needs and interests with respect to the general area of research on the economics of vocational education. Eventually we hope to identify the kinds of research vocational directors will find to be useful, select (from what we find in ERIC) appropriate models for that research, and develop effective training materials. Your responses on the enclosed questionnaire will contribute to that goal. Since only twenty selected individuals are participating in this survey, we hope you will respond with your best thinking.

Sincerely,

Harold R. Wallace
Professor

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Enclosure

CSU AND SBCCOE SURVEY

Part A

The purpose of this section is to determine how important several research procedures might be to provide useful input to your decision making.

This scale has been prepared so that you can indicate how you feel about each procedure. In each case, draw a circle around the number which represents your reaction as follows:

0 OF NO IMPORTANCE--Those procedures which you feel should not be undertaken because they would produce no beneficial information and in some cases may have an undesirable effect.

1 OF LIMITED IMPORTANCE--Those procedures which might produce some useful information but would have little beneficial effect.

2 OF CONSIDERABLE IMPORTANCE--Those procedures which might produce more than enough usable information to justify the time and cost of the research.

	Importance		
1. A cost-benefit procedure designed to reveal both monetary and non-monetary costs and benefits (such as job satisfaction or benefits to society)	2	1	0
2. A cost-benefit procedure designed to reveal only monetary costs and benefits (the model presented in your training session is an example)	2	1	0
3. A cost-effectiveness procedure designed to reveal monetary costs and results in terms of the degree to which program objectives are achieved (placements, employer satisfaction, etc.)	2	1	0

	Importance		
4. An effectiveness evaluation procedure designed to reveal results in terms of the achievement of program objectives (without reference to monetary costs)	2	1	0
5. A quality evaluation procedure designed to reveal how well the program compares with the ideal (using quality indicators such as having a well-qualified instructor, modern equipment, or a functioning advisory committee)	2	1	0

Comments:

CSU AND SBCCOE SURVEY

Part B

The purpose of this section is to determine opinions as to the cost-benefit analysis procedure and the materials used to train vocational administrators to use the procedure.

This scale has been prepared so that you can indicate how you feel about each question. In each case, draw a circle around the letter which represents your reaction as follows:

SA Strongly agree with the statement

A Agree but not strongly so

N Neutral or undecided

D Disagree but not strongly so

SD Strongly disagree with the statement

	Attitude
1. When I discovered actually what the training was about, I was disappointed. I expected something else. (If you agree, please comment on what you expected.)	SA A N D SD
_____	
_____	
_____	
2. I was disappointed to discover that the cost-benefit procedure was concerned only with monetary benefits resulting from student participation in the vocational program.	SA A N D SD
3. The calculation of benefits using census data struck me as being too complicated.	SA A N D SD

APPENDIX B

Training Materials

PROCEDURES MANUAL prepared by
Harold Wallace and Ted Hasselbring
as part of Project TIP

PART 1.3 ECONOMIC RESOURCES, COSTS AND BENEFITS

RATIONALE:

The purpose of this section is to outline a procedure for making a cost-benefit analysis of vocational education programs. The procedure does not require the use of sophisticated calculating equipment. A simple four function calculator will suffice. Nor does the person doing the study need special training nor expert computational skills, although he must be knowledgeable and capable of making sound judgments. The calculations take some time, but the results should be as defensible and accurate as the results of typical cost-benefits studies that are available.

Cost-benefit analysis is a systematic procedure used to compare the economic cost of a program with the economic benefits expected to flow from that program. Applied to education cost-benefit analysis investigates the economic results of education. It attempts to answer the question, "Does the training an individual or group receives increase the value of post-training production by an amount at least as great as the cost of the training?" If it does, the program may be economically justified. If it does not, the training has no economic justification because there are other uses for the scarce men and materials occupied in the training which would increase the productive potential of society. For example, the scarce resources might be diverted to other training programs which do yield a positive net economic payout. Or they might be used to produce capital goods which cause production to increase by more than enough to compensate for the cost of the capital goods.

A training program, if effective, will alter the economic skills and consequently the lifetime economic experience of the trainee. In cost-benefit

analysis, economic productivity is gauged by income earned. Figure 1 depicts two hypothetical age-income profiles for the same worker. The solid line connecting a,b,e, and f indicates the person's production (income) that would have occurred without training; and the dotted line connecting a,b,c,d,e, and g shows the person's production if he entered the training program at age 20. The dotted line declines below the x axis during the training program indicating that the trainee is using up goods and services rather than producing them during the training period.

The methodology of cost-benefit analysis involves comparing the area under the solid line with the area under the dotted line. In other words, it compares the total income that would have been received by the individual without training with the total income the individual receives with training after subtracting the costs of training from the income received with training.

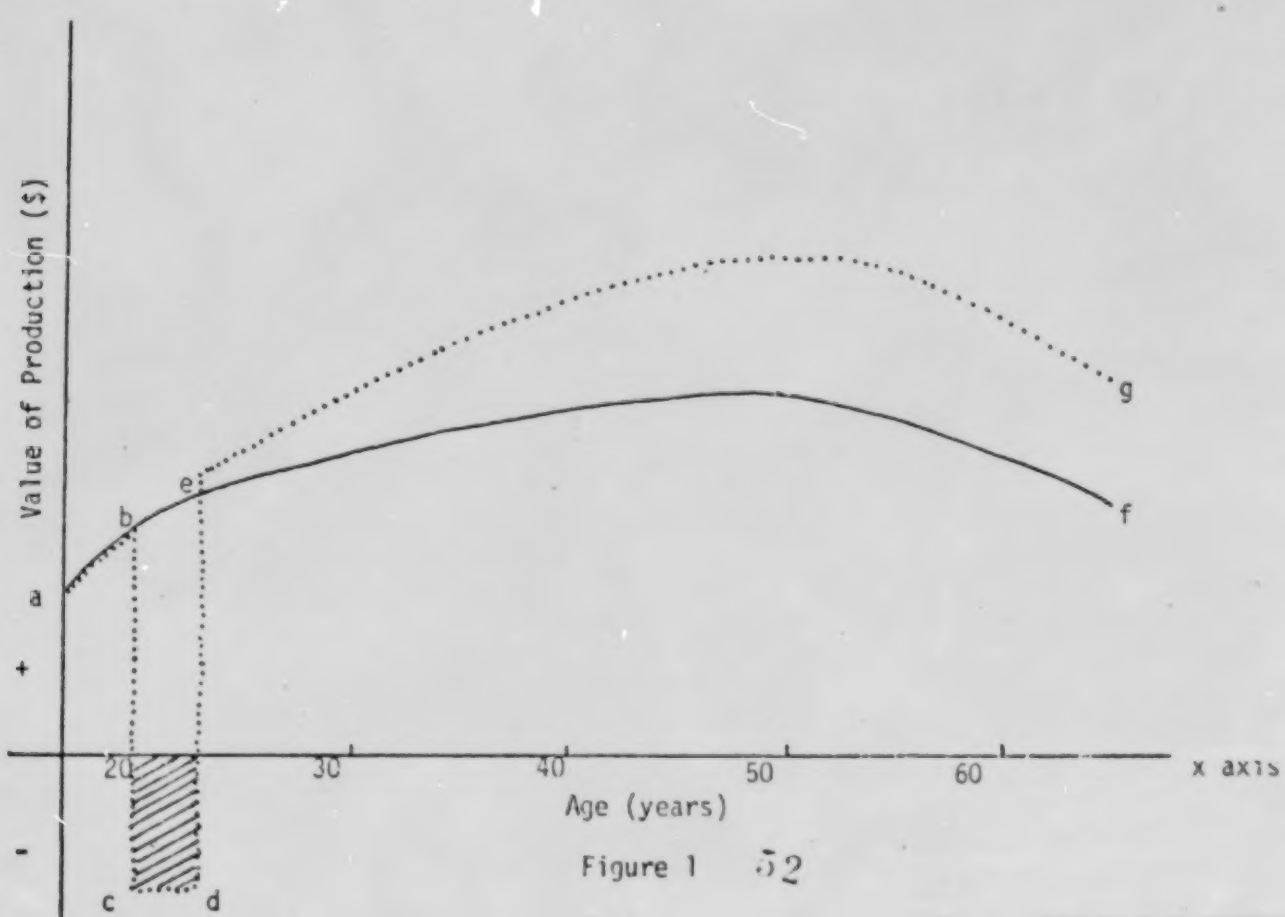


Figure 1

Opportunity cost is the basic cost concept used in virtually all economic decision making. It can be defined as the alternatives given up as a result of making a particular decision. For example, the opportunity costs of attending a college class includes the alternative activities foregone by a student who chooses to be in class plus the goods and services he could have purchased with the money he paid for tuition. Likewise, the opportunity costs to society of providing a vocational education program include 1) the money costs of that program which represent the value of other goods and services that could have been produced with the resources taken up by the training program and 2) the income the people involved in the training program could have generated had they been productive workers instead of using their time to receive training.

In terms of Figure 1, therefore, the opportunity cost of the training program includes the area under the solid line from age 20 to the end of the individual's work life plus the shaded area between the dotted line and the x axis. That area between the axis and the portion of the dotted line below the axis represents the money cost of the training program. The total benefits to society include the area under the dotted line from the date of program completion until the end of the trainee's work life.

At this point it may appear that a program which generates greater benefits than costs is always economically justified. While we can say with certainty that a program which generates less benefits than costs is not justified, we do not have enough resources to undertake all programs with benefits greater than costs. Therefore, it is necessary to make a choice between a variety of programs all of which have positive

net benefits. In order to choose rationally between such programs it is necessary to compare the rates by which benefits exceed costs for alternative uses of productive resources. Consequently, the last step in cost-benefit analysis is to calculate the rate by which benefits exceed costs. Economic welfare will always be enhanced if resources can be shifted from the less to the more productive programs, i.e. from programs whose benefits exceed costs by lower rates to programs whose benefits exceed costs by higher rates.

ACTIVITY I

Complete a cost-benefit analysis of a vocational program

INTRODUCTION:

The nine-column worksheet in the Supplementary Materials will serve as the focus for the step-by-step analysis outlined below. The instructions for use of the worksheet are also included in the Supplementary Materials, rather than being presented as a separate procedure. It is suggested that you study the instructions and worksheet example before you attempt to follow the procedure using your own data. Starting with column 1, instructions will be given for completing each column of the worksheet. Following the instructions, a hypothetical example will be presented.

OBJECTIVE OF THIS ACTIVITY:

You will be able to complete a cost-benefit analysis of a vocational education program using the nine-column worksheet and a desk calculator.

PROCEDURES:

1. Study the instructions and worksheet found in the Supplementary Materials.
2. Follow the procedure using information pertinent to the program you are evaluating.

SAMPLE WORKSHEET FOR COST-BENEFIT ANALYSIS

Trainee Age	Direct Training Costs per Trainee	Indirect or Allocated Costs per Trainee	Pre-Training Income Expectations	Opportunity Costs per Trainee	Post-Training Income Expectations	Annual Net Undiscounted Benefits per Trainee	Discounted Benefits Rate 1	Discounted Benefits Rate 2
Column # 1	2	3	4	5	6	7	8	9
20	465	969	5188	6622	00	-6622	-6020	-6247
21			5188	5188	7090	1902	1572	1693
22			7471	7471	7090	- 381	- 286	- 320
23			7471	7471	7090	- 381	- 260	- 302
24			7471	7471	7090	- 381	- 237	- 285
25			10272	10272	12053	1781	1005	1256
26			10272	10272	12053	1781	914	1184
27			10272	10272	12053	1781	831	1117
28			10272	10272	12053	1781	755	1054
29			10272	10272	12053	1781	687	995
30			11725	11725	12053	328	115	173
31			11725	11725	12053	328	105	163
32			11725	11725	12053	328	95	154
33			11725	11725	12053	328	86	145
34			11725	11725	12053	328	79	137
35			13022	13022	13471	449	93	177
36			13022	13022	13471	449	89	167
37			13022	13022	13471	449	81	157
38			13022	13022	13471	449	73	148
39			13022	13022	13471	449	67	140
40			13022	13022	13471	449	61	132
41			13022	13022	13471	449	55	125
42			13022	13022	13471	449	50	118
43			13022	13022	13471	449	46	111
44			13022	13022	13471	449	41	105
45			13541	13541	13471	- 70	- 6	- 15
46			13541	13541	13471	- 70	- 5	- 15
47			13541	13541	13471	- 70	- 5	- 14
48			13541	13541	13471	- 70	- 4	- 13
49			13541	13541	13471	- 70	- 4	- 12
50			13541	13541	13471	- 70	- 4	- 12
51			13541	13541	13471	- 70	- 3	- 11
52			13541	13541	13471	- 70	- 3	- 10
53			13541	13541	13471	- 70	- 3	- 10
54			13541	13541	13471	- 70	- 2	- 9
55			12607	12607	12124	- 483	- 16	- 59
56			12607	12607	12124	- 483	- 14	- 56
57			12607	12607	12124	- 483	- 13	- 53
58			12607	12607	12124	- 483	- 12	- 50
59			12607	12607	12124	- 483	- 11	- 47
60			12607	12607	12124	- 483	- 10	- 44
61			12607	12607	12124	- 483	- 9	- 42
62			12607	12607	12124	- 483	- 8	- 39
					TOTAL		- 30.62	+1785.48

Guidelines for Using the Cost-Benefit Analysis Worksheet

WORKSHEET COLUMN ONE

"Trainee Age"

INSTRUCTIONS

Column 1 lists the trainee's ages in years from the beginning of the training to the end of the trainee's work life. The trainee's entire work life must be considered because a training program, if it is effective, may influence the trainee's job selection and job experience for the remainder of his work life.

First Year. The first age entered in worksheet column 1 should be the age of the trainee at the beginning of the training program. Should a class of trainees be considered, the average age of the class at the beginning of the training program should be the first year entered.

The beginning age should be incremented by one as entries are made moving line by line down the page.

Last Year. The last year is determined from column 2 of Table 11. Table 11 shows the average number of years of labor force participation remaining for men of each age.[1]

EXAMPLE

Assume that a beginning class in auto mechanics has an average age of 19.5. Rounding this age up to 20 and checking Table 11 indicates that the average number of years as a labor force participant for males age 20 is 41.5, which has been rounded up to 42. Therefore, the beginning age of worksheet column 1 is 20. The last age is 20 plus 42 which is 62. The

[1] In using Table 11 any consistent rule on rounding might be applied. In the example I have rounded up if the fraction of the year was .5 or more and rounded down if less than .5.

ages appearing in column 1 are consecutive ages starting with 20 and ending with 62.

WORKSHEET COLUMNS 2 AND 3

"Direct Training Costs Per Trainee" and "Indirect or Allocated Costs Per Trainee"

INSTRUCTIONS

The money costs of purchasing the inputs required to run a training program serve as a proxy for the opportunity cost to society of using those inputs to operate the training program. This is a very clean cut, straight forward amount when the accounting costs coincide with training costs. In this study such costs will be referred to as direct costs. However, some accounting costs are not recorded on a program by program basis. Such accounting costs are shared or "joint" for several programs. Consequently, it is necessary to make a judgment about the fair share of "joint" costs to attribute to the training program under study. These costs will be called indirect or allocated costs.

Direct Training Costs. Direct training costs may be defined as money expenditures, the timing of which is generally coincident with the training program and which are exclusively related to the program. If it is a continuation of an ongoing training program, past accounting data on costs will be available for use in making cost estimates. Direct costs for a new program must be estimated on the basis of the best available information. Typical examples of direct training costs include salaries of teachers, materials, paper, fuel, books, lights, etc.

Indirect or Allocated Costs. Indirect or allocated costs are training related costs which cannot be attributed exclusively to one group of

trainees. Costs must be allocated for one of two reasons: a) money expenditures made for inputs like machines or buildings with useful lives which exceed the time it takes to complete a single training program, or b) money expenditures for the purchase of inputs, like fuel for a furnace which heats a building, which serve two or more concurrent programs. In either of these cases it would be incorrect to attribute the entire cost figure as it would usually be found in the accounting records to a single training program.

a) Allocation of Indirect Costs Over Time. If long lasting assets are being rented, the annual rent payments would fall within our definition of direct training costs and would be included there. Of course, this would make an allocation unnecessary. However, in most cases buildings, machines and other durable assets are not rented; therefore, an allocation of part of the asset's cost must be made to the training program. The simplest and most defensible method of calculating such a cost is to compute the annual amortization of the asset over its expected life.

The annual amortization cost is a single figure which really includes two cost considerations. First, it includes a depreciation factor which recognizes that a long lasting asset is gradually wearing out. One approach to depreciation is to assume that a fraction of the asset's value equal to the fraction of the time that a training program has used the asset should be charged to the training program. Also included in the figure is an interest charge. The interest rate used in the calculation recognizes the opportunity cost of having resources committed to the asset. The interest rate provides an estimate of the productivity of those resources that were used in alternative ways. Therefore, the amortization charge

includes not only the value of the asset used up but also the opportunity costs of having resources tied up in the asset.

Table 12 is used to calculate the annual amortization cost of an asset. Two estimates must be made to use Table 12. First, the expected useful life of the asset in years and second the rate of interest.

The expected useful life identifies the time over which the assets can reasonably be expected to remain in use. Estimates of expected useful life can be made from the past history of similar assets, bureau of internal revenue regulations, conventional accounting practices, are simply judgments based on experience.

The proper interest rate column in Table 12 remains a source of some debate, but a defensible practice is to use an average of the yields on government bonds over a period of years in the future that matches the expected useful life of the assets.

Annual amortization costs should be estimated for each long lasting asset or for each class of long lasting assets used in the training program. The annual amortization costs for all assets are then summed to obtain the total indirect or allocated cost which must be divided by the number of students trained to obtain the entry in worksheet column 2.

The annual amortization expense is calculated as follows: Select a row number from Table 12 identical to the estimated life of the asset. Go along that row to the column which matches the interest rate most nearly equal to that computed by taking the average of the yields on government bonds. Select the factor from Table 12 which falls in that row and that column. Dividing that factor into the original cost of the asset gives the annual amortization expense for that asset.

b) Allocation of Indirect Costs Between Concurrent Programs. Some accounting costs cover inputs used simultaneously in two or more training programs. In such cases reasonable allocators, such as percent of floor space occupied or percent of lighting wattage available, should be used to allocate the joint cost between programs.

Costs Per Trainee. Worksheet columns 2 and 3 both call for costs on a per trainee basis. Therefore, both the total direct cost and the total indirect cost for the class of trainees must be divided by the number of students trained to obtain the entries for worksheet columns 2 and 3. Care must be exercised to match the time period over which the cost data was collected to the number of students trained over the identical period. Because students may drop out during the program, the number of students completing the program is a better indicator of the number of students trained than the number enrolled in the program. And, since some students may repeat the program, there is more training per completing student than the typical training period would indicate. One approach to this problem is to calculate the training years per completing student and calculate the cost of running the training program for that same time span. Alternatively, the trainees completing training per year of program operation might be divided into the cost of operating the program for one year.

EXAMPLE

Allocation Between Concurrent Programs. To continue the hypothetical example concerning the vocational training class in auto mechanics in which the average age was 20 years, let us assume that the auto mechanics training program was housed in a building which houses other functions as well. This will necessitate allocation of direct costs such as heating,

custodial services, and power. Assume that the accounting records reveal that the heating costs for the building were $1,500, the custodial expense including salary and supplies $11,000, and the cost of power to the building was $2,000. Inspection of the premises indicates that about 50 percent of the heating bill, 75 percent of the power bill, and 67 percent of the custodial services can be attributed to the training program. Allocation of these three direct costs is illustrated in the following table:

Direct Cost To Be Allocated	Total Amount To Be Allocated	Basis For Allocation	Percent Allocated To Training Program	Allocated Direct Costs
Heating	$ 1,500	Percent of Floor Space Utilized	50%	$ 750.00
Custodial	11,000	Percent of Time Occupied	67%	7,370.00
Power	2,000	Percent of Horsepower Available	75%	1,500.00
Total Direct Costs Allocated to Training Program				$9,620.00

Table 1

Allocation Over Time. Because the auto mechanics training program uses several long lasting assets, it will also be necessary to calculate an annual amortization figure for each of these assets. Assume that the building in which the auto mechanics class is housed had an original cost of $90,000, and it has an expected useful life of 30 years. The building cost requires not only a calculation of the annual amortization (allocation over time) but also an allocation to concurrent programs since only half of the building is being used for the auto mechanics training program. In addition, the training program is the only current user of several machines

which had an original total cost of $80,000 and an average expected use life of eight years. Also, tools which had an original cost of $10,000 and which, from past experience, can be expected to have a useful life of four years are being employed exclusively in the auto mechanics program.

Besides the information just given, a rate of interest is needed before one can make the calculation of the total annual amortization which should be allocated to the training program. One method of arriving at a rate of interest is to obtain a recent copy of the Wall Street Journal. On one of the back pages is a report of Government Agency and Miscellaneous Securities which shows the bid and asked prices and yields for U. S. treasury bonds and notes. (See Illustration 1.) From this can be constructed a table showing yields on the quotation date for bonds maturing each year until the last outstanding treasury bond issue matures. For those years in which no issues mature, continue the same rate as for the last previously maturing issue. Table 13 shows the annual yields used in calculating the rate of interest for the three useful life expectancies applied to tools, machines, and buildings respectively. The 6.93 percent calculated for machines is closest to the 7 percent column in Table 12. The 7.33 percent which is the average yield on bonds maturing over the next 8 years is closest to the 7.5 percent column in Table 12. And the 6.48 percent which is the average on bonds which will be maturing over the next 30 years is closest to the 6.5 percent column in Table 12.

The calculation of the annual amortization for the three asset classes in the example is demonstrated below:

Column 1	2	3	4	5
Asset	Asset Cost	Expected Life (in years)	Discount Rate (annual percentage)	Factor From Table 12
Tools	10,000	4	7.0	3.387
Machines	80,000	8	7.5	5.857
Building	90,000	30	6.5	13.059

Column 6	7	8
Annual Amortization (Column 2/Column 5)	Allocation	Indirect Cost of Training Program
2,952.28	100%	$ 2,952.28
13,658.16	100%	13,658.16
6,891.97	50%	3,445.99

Total Annual Indirect Costs Allocated to Training $20,056.43

Table 2

To obtain the entries for worksheet columns 2 and 3, it is necessary to divide both total direct and total indirect costs as computed above by the number of students trained during a period identical to the time span over which the cost data is collected.

Assume that all the cost data above applies to one year of running the training program. Typical trainees complete the program in one year. There are some dropouts and repeaters, however. Assume that of 26 beginning students 23 completed the course. Of the 23 who finished two have repeated. One repeated the entire course while another repeated half the course. Therefore, there were

21 who trained one year = 21 x 1 = 21 man years

1 who trained two years = 1 x 2 = 2 man years

1 who trained one and one-half years = 1 x 1½ = 1½ man years

Total man years of training in this class = 25½

The training per completing student was $\frac{25\frac{1}{2}}{23}$ = 1.11 years.

Because the 23 graduates attended school for an average of 1.11 years each, we must divide the number of graduates into the cost of running the training program for 1.11 years. This gives us the figures for worksheet columns 2 and 3.

Worksheet Column 2

$$\frac{9,620,00 \times 1.11}{23} = \$464.27$$

Worksheet Column 3

$$\frac{20,056.43 \times 1.11}{23} = \$967.94$$

Alternatively, we could have calculated the number of graduates per year of training = $\frac{23}{25.5} = .90$. Although there were 23 finishers this year, one year of training trained only 23 x .9 = 20.7 students. Since cost data is on an annual basis, we could obtain figures for worksheet columns 2 and 3 as follows:

Worksheet Column 2

$$\frac{9,620.00}{23(.90)} = \$464.73$$

Worksheet Column 3

$$\frac{20,056.43}{23(.90)} = \$968.91$$

The slight differences between these per-trainee cost figures and those in the previous example are attributable entirely to rounding.

WORKSHEET COLUMNS 4 AND 6

"Pre-training Income Expectations per Trainee"
"Post-training Income Expectations per Trainee"

INSTRUCTIONS

Worksheet columns 4 and 6 each calls for a calculation of annual incomes a trainee could expect to earn during his or her working life. Earnings over all the years of an individual's expected working life will be referred

to as an age-income profile.

Worksheet column 4 shows annual earnings a trainee could have expected had he gone through his working life without vocational education. Vocational training takes him off his pre-training earnings track and places him on a new earnings track. Therefore, the amounts the trainee would have produced had his time and energy not been diverted to vocational education is an opportunity cost to society--production society loses because of that diversion.

Worksheet column 6 shows annual earnings the trainee can be expected to receive over his working life after having had vocational training. These amounts can be considered training connected benefits to society. Post-training earnings must more than compensate for the pre-training earnings which were sacrificed for the training program if the program's economic benefits are to exceed its economic costs.

Two specific assumptions are needed to generate an age-income profile: (1) a starting place or a beginning amount and (2) a time path or age-earnings pattern over the balance of the subject's working life.

Beginning Amount. The beginning amount, which is entered as the earnings during the first year of the age-income profile, is an estimate of the average or mean earnings of the population or group to which the individual belongs. Of course, there will be significant variation in the earnings of the individuals included in the population. The mean is used because it is the single number which most accurately represents the entire population.

Worksheet column 4, first year, should show the current mean earnings of the population to which the trainee belonged just prior to the beginning of training. This information may be obtained by adjusting earnings garnered from secondary sources or from a survey of a sample of that part of the pre-

training population which has not obtained additional formal general education nor vocational training. Such a survey, if properly done requires time, money, and skill. Secondary data, as noted below, must be used with care to make worksheet columns 4 and 6 comparable.

Worksheet column 6, beginning amount, should show the average earnings of the trainees the first year after completing training. This information may be estimated from secondary sources similar to those used to obtain beginning year data in column 4; or it may be determined by surveying the persons who participated in the training program. Average income currently being received by the total work force employed in the vocation trained for is usually not appropriate to use as the beginning amount in column 6 because all trainees usually do not enter that vocation and because the average age of the people in the occupation will typically be older than the average for the trainees.

The difference between the earnings data entered in worksheet columns 4 and 6 is critical to the outcome of the cost-benefit analysis. It is important, therefore, that the difference between the two columns represents real rather than specious differences in the earnings prospects between persons without and persons with training.

When secondary data sources such as the census are used, there are several potential sources of specious differences in the incomes entered in the two columns which could negate the study's validity. Among these are:

(1) using different income definitions. Three major possibilities for error exist.

a) Some census figures measure money incomes; others measure earnings. Money income includes non-earned elements such as property income, unemployment compensation, welfare payments, veterans benefits

payments, etc. in addition to earnings. Ideally, the beginning figure in worksheet columns 4 and 6 should both be either earnings or money income.

b) Some census information on income or earnings give mean incomes for all individuals who had income during the year; other tables present mean incomes for full-time workers or workers who have worked 50 weeks or more. Needless to say, unemployment reduces the mean income for all workers with income below the mean income for year around, full-time workers. Again, it is important that in completing worksheet columns 4 and 6 the same income measure is used.

c) Data entered in worksheet column 6 especially may be taken from a survey of actual post-training jobs of trainees. Caution should be exercised in the manner in which hourly earnings are converted to annual earnings to make worksheet columns 6 and 4 comparable. Annual earnings, for example, may have built into them part-time employment or overtime pay; but one may be tempted to convert an hourly wage into annual earnings amount by multiplying the hourly wage x 8 hours a day x 5 days a week x 52.14 weeks. (Hourly wage x 2085.71). This may or may not be comparable to a column 4 figure which gave annual income for an unspecified number of hours of work.

(2) using incomes for different geographic regions in worksheet column 4 than in column 6. There may be significant differences between earnings in different geographic areas even for workers of similar ages in the same occupation. It is a mistake, however, to use local earnings exclusively in cost-benefit analysis. Trainees are typically young, and the amount of geographic migration over worker's lifetimes is considerable. Certain sponsors of vocational education are so provincial that they will sponsor training programs only if local jobs are available for graduates. Yet

evidence is plentiful that young, skilled trainees are attracted to jobs on a regional or a national level. Therefore, using regional or national earnings figures in worksheet columns 4 and 6 is not ill advised.

(3) using earnings in worksheet column 6 which were measured a year or more later than the earnings of column 4. This will cause the difference between the two columns to reflect inflation as well as productivity differences whenever money rates have been changing over time. For example, 20-year-old non-trained workers have been receiving higher and higher wages. To prevent inflation from biasing the cost-benefit analysis it is necessary to measure beginning earnings in worksheet columns 4 and 6 for an identical year. That year should be the same year for which costs appearing in worksheet columns 2 and 3 have been calculated.

Age-Earning Pattern. Average annual earnings typically change with age over working people's working lives. Graph 1 shows a more or less typical age-earning profile with earnings increasing at a decreasing rate until the middle forties or early fifties and thereafter declining.

Census data contains mean earnings by age category, by profession and by education. This can be used as a basis for projecting the beginning years earnings in worksheet columns 4 and 6 through the individual's work life. To do this calculate for each year of work life the ratio of earnings during that year to earnings during the beginning age. Hereafter this will be referred to as the age-income ratio. The age-income profile can then be completed by multiplying the beginning age income by the age-income ratio for each subsequent age.

EXAMPLE

Continuing our example of the auto mechanics class, assume that no primary survey data is available on earnings of the pre-training population.

Assume also that it is a new program so that there is no post-training earnings experience available to draw from. Under these restrictive circumstances it will be necessary to obtain information for worksheet columns 4 and 6 from secondary sources. The fact that this example uses secondary rather than primary data does not imply that secondary data is preferred. The mechanical details of the calculation are the same. The example will serve the purpose of acquainting readers with some sources of secondary data.

Focusing on worksheet column 4, assume that preliminary sign up information indicates that about half those who sign up for the training course will be high school graduates. The other half will be persons with some high school education who did not graduate. It appears that all enrollees will be males and they will be racially mixed.

From U.S. Bureau of the Census, Census of Population: 1970, Subject Reports, Educational Attainment, we obtain the "Total Income of Males 14 Years Old and Over With Income in 1969 by Years of School Completed, Age, and Race." It provides the following mean income data.

	Age						
Education	20-21	22-24	25-29	30-34	35-44	45-54	55-64
Completed 1 to 3 Years of High School	3450	4855	6531	7446	8317	8517	7937
Completed 4 Years of High School	3706	5450	7660	8744	9688	10229	9515

Table 3

Several things should be noted about this data. 1) It is for 1969. Therefore, the beginning amount should be multipled by a factor equal to the ratio of 1975 income to 1969 income. 2) It is income rather than earnings. That fact should not be forgotten when worksheet column 6 is

completed because we would prefer identical income definitions in the two columns. 3) It is for all males with income rather than for full-time workers. This builds into the data a factor for part-time unemployment. Column 6 should, therefore, show mean income for all who have received income rather than for full-time employees.

To obtain the beginning income for worksheet column 4 it is necessary to adjust 1969 income upward by a factor which will give a reasonable estimate of 1975 income. The Monthly Labor Review, a monthly periodical published by the U.S. Department of Labor, Bureau of Labor Statistics, contains quarterly indexes of compensation per man hour in the private, nonfarm sector of the economy. Table 31 of the April 1975 issue indicates a 1969 index of 122.6 and a 1974 index of 162.1. In addition Table 35 shows wage and benefit settlements in major collective bargaining units. Wage rate settlements in 1974 suggest that money earnings in 1975 will be about 10 percent above 1974. Adding 10 percent to the index of 162.1 for 1974 yields 178.31 as the anticipated index for 1975. The factor needed to adjust 1969 income to 1975 income is 178.31/122.6 = 1.45. Therefore, the beginning income in worksheet column 4 should be the weighted average of the 1975 income at age 20 of a group made up of 50 percent high school graduates and 50 percent who had one to three years of high school. The calculation of the beginning income for worksheet column 4 is as follows:

	Weight	x 1969 Income	x Adjustment Factor	= 1975 Income
1-3 Years High School	.5	3450	1.45	$2,501.25
4 Years High School	.5	3706	1.45	2,686.85
			Weighted Average	$5,188.10

Table 4

The next step is to fill out the expected annual incomes over the working life of these individuals had they not received further training. The age-income pattern can be identified from the census data presented above. It indicates that incomes in ages subsequent to age 20 bear the following age-income ratios to income at age 20: (The age-income ratio is the ratio of income for the specified age divided by income at age 20. For example, males who had completed 1 to 3 years of high school age 22-24 earned mean incomes of $4855. Therefore, for this group the age-income ratio for ages 22, 23, and 24 is $4855/$3450 = 1.41.)

Ages	Ratio of Income $\frac{\text{age N}}{\text{age 20}}$ 1-3 Years High School	x Weight	+ Ratio of Income $\frac{\text{age N}}{\text{age 20}}$ 4 Years High School	x Weight	= Weighted Average Ratio
21	1.00	.5	1.00	.5	1.00
22-24	1.41	.5	1.47	.5	1.44
25-29	1.89	.5	2.07	.5	1.98
30-34	2.16	.5	2.36	.5	2.26
35-44	2.41	.5	2.61	.5	2.51
45-54	2.47	.5	2.76	.5	2.61
55-64	2.30	.5	2.57	.5	2.43

Table 5

The lines in worksheet column 4 are completed by multiplying the income for the beginning age, $5,188.10, by the appropriate age-income ratio. Calculations to complete the example are as follows:

Ages	Beginning Income	x Age-Income Ratio	= Entries for Worksheet Column 4
20	5,188.10	1.00	5,188.10
21	5,188.10	1.00	5,188.10
22-24	5,188.10	1.44	7,470.86
25-29	5,188.10	1.98	10,272.44

Ages	Beginning Income	x Age-Income Ratio	= Entries for Worksheet Column 4
30-34	5,188.10	2.26	11,725.11
35-44	5,188.10	2.51	13,022.13
45-54	5,188.10	2.61	13,540.94
55-64	5,188.10	2.43	12,607.08

Table 6

The completion of worksheet column 6 involves identifying the beginning income of the post-training population and projecting that income in accordance with a relevant age-earnings pattern. On-going training programs would generate a continuing flow of data on earnings of program graduates. Under the assumption of this example, however, there is no post-training earnings experience to draw from. It is necessary, therefore, to turn to secondary data. The information sought will be for a population similar to that for which income was measured in worksheet column 4.

From U.S. Bureau of the Census, Census of Population: 1970, Subject Reports, Earnings by Occupation and Education can be obtained "Earnings and Occupation of Total and White Males 25 to 64 Years Old in the Experienced Civilian Labor Force With Earnings in 1969, by Work Experience in 1969, Years of School Completed, and Age." It provides the following data:

Mean Earnings of Automobile Mechanics and Body Repairmen

	Age		
Education	25-34	35-54	55-64
Completed 1 to 3 Years Of High School	7057	8023	7127
Completed 4 Years of High School	7789	8535	7771

Table 7

This data is not comparable to the Census data used as a basis for completing worksheet column 4. It must, therefore, be adjusted.

(1) Column 4 was based on money incomes whereas the information above is earnings. (2) No reanings for automobile mechanics under age 25 is presented. Adjustments for both of these differences are possible. Information on the ratio of income to earnings is available in another Bureau of the Census publication. In U.S. Bureau of the Census, Current Population Reports, Series P-60, No. 90, "Money Income in 1972 of Families and Persons in the United States," Table 65 can be found type of income in 1972 for persons. It shows the following breakdown between earned money income and total money income for all males:

	Number of Recipients	Mean Income	Total Earnings or Income
Earned Wage or Salary Income	53.668 million	8529	$474.8 billion
Earned Nonfarm Self-Employment Income	5.906 million	8390	49.6 billion
Earned Farm Self-Employment Income	2.811 million	3411	9.9 billion
Total Earned			534.3 billion
Income Other Than Earnings	35.544 million	1841	65.4 billion
Total Income			$599.7 billion

Ratio of Total Income To Earned Income = 599.7 ÷ 534.3 = 1.12.

Table 8

Therefore, the mean earnings of automobile mechanics and body repairmen can be multiplied by 1.12 to obtain an approximation of their mean money income.

The second shortcoming of the data on earnings of auto mechanics, that no earnings data was presented for persons under 25 years of age, can be easily and fairly accurately rectified by assuming the same age-earnings profile at early ages as is experienced by other craftsmen. For example, U.S. Bureau of the Census, Census Population: 1970, Subject Reports, Vocational Education, presents "Earnings in 1969 of All Persons 16 Years Old

and Over by Field of Vocational Training, Years of School Completed, Age and Sex." The following is mean earnings of males trained in trades and crafts:

Education	Age 20-24	Age 25-34	Age-Income Ratio
0-3 Years of High School	4524	7613	1.68
4 Years of High School	5055	8648	1.71
Mean Age-Income Ratio			1.70

Table 9

Therefore, the unadjusted beginning income can be found by dividing the weighted mean incomes for 25-34 year-olds with one to three years high school education and with four years of high school education by 1.7. Beginning Income = $\frac{7057 \times .5 + 7789 \times .5}{1.7}$ = $4366.

Age-income ratios can be computed as follows:

Ages	Ratio of Income 1-3 Years High School	Weight	Ratio of Income 4 Years High School	Weight	Weighted Average Ratio
20-24	1.00	.5	1.00	.5	1.00
25-34	1.70	.5	1.70	.5	1.70
35-54	1.93	.5	1.86	.5	1.90
54-64	1.72	.5	1.70	.5	1.71

Table 10

The entries for worksheet column 6 can now be calculated:

Ages	Beginning Earnings 1969	x	Earnings to Income Adjustment	=	Beginning Income 1969	x	Time Adjustment Factor	=	Beginning Income 1975	x	Age-Income Ratio	=
20-24	4366		1.12		4890		1.45		7090		1.00	
25-34											1.70	
35-54											1.90	
55-64											1.71	

Column 6 Worksheet Entries
7,090
12,053
13,471
12,124

Table 11

WORKSHEET COLUMNS 5 AND 7

"Opportunity Cost Per Trainee"
"Annual Net Undiscounted Social Benefits Per Trainee"

Worksheet column 5 row entries are simply the sums of the row entries for columns 2, 3, and 4. Combined, these row entries show the per trainee annual opportunity cost to society of the training program. The sum of the row entries shows the total, undiscounted opportunity cost per trainee to society.

Worksheet column 7 row entries are the difference between row entries in column 6 and the row entries in column 5.

Column 6 entries showed the annual post-training income per trainee. Subtracting from column 6 entries, row 5 entries (the production that would have occurred without training plus the monetary cost of training) yield the net undiscounted benefits or losses society can expect per trainee.

WORKSHEET COLUMNS 8 AND 9

"Discounted Benefits Rate 1"
"Discounted Benefits Rate 2"

Worksheet columns 8 and 9 are similar because row entries for each of these columns were arrived at by discounting column 7 row entries. The only difference between columns 8 and 9 is that different discount rates have been applied to column 7 entries.

The purpose of calculating cost-benefit ratios is to derive the annual rate of return which vocational training will yield on the cost of the training. The annual rate of return society can expect to receive by investing in this particular training program can be compared with the projects. Clearly, from a purely economic vantage point society's resources should be applied to those projects from which the rate of return is the greatest.

Discounting future costs and returns is necessary because a dollar received or expended in the future is not equivalent to a dollar received or expended now. This difference exists because society pays interest for the use of money; therefore, a dollar when loaned can earn interest which when added to the dollar (compounded) increases the future sum that a present dollar can bring. For example, if the interest rate is 10%, a dollar loaned out now will bring $1.10 one year from now. If it is loaned out for two years and interest is compounded (added to principle) annually, the dollar plus interest will have accumulated to $1.21; in three years to $1.33; in 10 years to $2.59, etc.

Reversing the process one can ask the question. "What amount invested now at a 10% rate of interest would accumulate to $1.10 a year from now?" The answer, $1.00, is called the present value or discounted value of $1.10 which is to be received one year hence. If the interest rate is 10%, the present value or discounted value of $1.21 to be received two years from now is also $1.00, because $1.00 invested now would, when interest is added annually, accumulate to $1.21 in two years.

The formula used to calculate the present value of a payment to be received in the future is $PV = \frac{FVn}{(1+i)^n}$; where PV = present value

FV = the amount of the payment to be received in the future (future value)

i = the rate of interest (rate of discount)

n = the number of years between the present and the time when the payment will be received

To illustrate, suppose $100 will be paid to a person in 10 years. If the current interest rate is 8 percent what is the present value of the $100? Plugging the data into the above formula gives $PV=\frac{100}{(1.08)^{10}}$ = $46.32. Turning the problem around, we could ask, "How much money would a person receive 10 years from now if he were to put $46.32 at interest for 10 years at 8 percent interest compounded annually. Of course, the answer is $100.00.

The factor $\frac{1}{(1+i)^n}$ can be found in Table 14. There is a row in Table 14 for each year counting from the present and a column for each of several selected rates of discount. Since the $100 in the above problem will be received 10 years from now, year 10 in Table 14 is the proper row. Because the interest rate is 8 percent we follow row 10 across to the 8 percent column where .463 is the number indicated. Multiplying $100 by .463 yields $46.30, the same answer, except for rounding, as calculated previously. In the present instance, however, the value of $\frac{1}{(1.09)^{10}}$ was found in Table 14.

To complete worksheet column 8, select an arbitrary rate of discount such as 10% or 15%. Using the discount rate selected calculate the present value of each row entry in worksheet column 7 and enter the calculated present value in the same row in worksheet column 8. After all column 7 rows are discounted and the discounted amounts entered in column 8, sum column 8. This sum represents the net present value of the training program when the net benefits are discounted using the arbitrarily selected rate of interest.

The rate of return society is receiving on the training program investment is the rate of discount applied to column 7 which makes the sum of column 8 equal to zero. Because it is extremely improbable that the arbitarily selected rate of discount used to calculate the entries for column 8 is the rate which will make the sum of column 8 equal zero, it is nearly always necessary to select a second rate of discount and go through the discounting process one more time.

The second rate of discount should be set so that the sum of entries in column 9 will have the opposite sign from the sum of entries in column 8. For example, using a first discount rate of 8%, suppose the sum of discounted entries in column 8 were a plus $1,000. Since we are seeking a sum equal to zero for column 8, this indicates that the rate of discount was too low. The rate of discount used to calculate column 9 should be increased enough to bring the sum for column 9 to zero or below zero. Once two present values are established a graph such as the one below can be drawn and used to make a close estimate of the actual rate return. The x and y scales should be established to comfortably accommodate the results of the specific problem being solved. The scales need not be identical to those in the example.

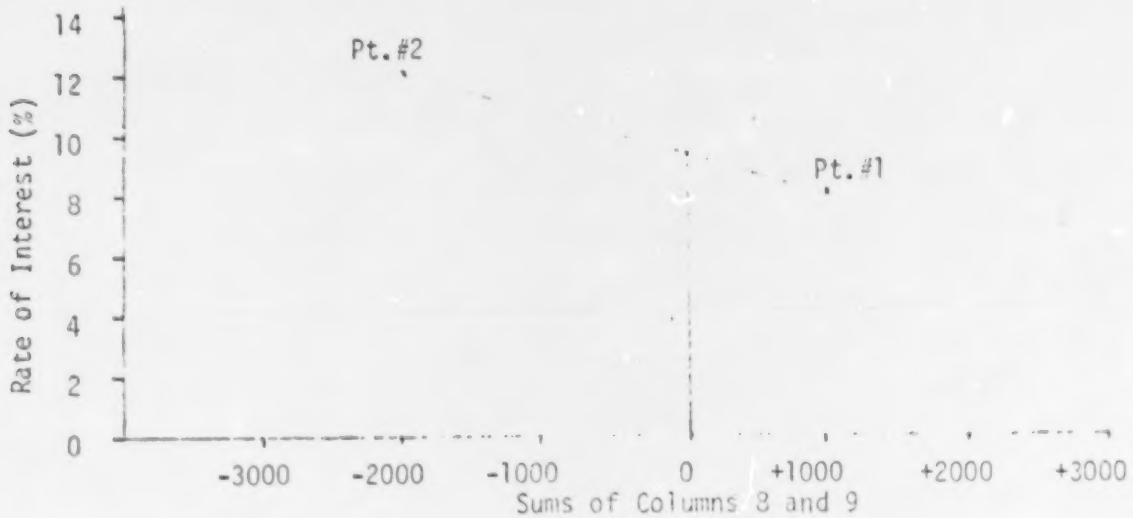


Figure 2

To use the graph, first plot the combination of discount rate and present value from column 8. The illustration from the above paragraph would give point #1 on the graph. Since the present value was too high, choose a higher discount rate for making the entries in column 9. Assume the discount rate chosen was 12% and the sum of discounted values in column 9 turned out to be -$2000. Plotting that combination at point #2 on the graph permits us to draw a straight line between points 1 and 2. The rate of interest at which that line crosses the vertical line designating a zero present value on the horizontal axis, is a close estimate of the rate of return on the training program. On the graph that rate is between 9% and 10%.

EXAMPLE

Returning to the example of the auto mechanics class, examination of column 7 indicates that the rate of return is positive, i.e. the benefits exceed the costs. Had the costs exceeded benefits (the sum of column 7 been negative) completing columns 8 and 9 would have been unnecessary since a program which costs more than it adds to production is economically not justified.

Arbitrarily selecting 10% as a discount rate, row entries for worksheet column 8 can be completed. The first entry is calculated by multiplying -6622 from column 7 by $\frac{1}{(1.1)^1}$ = (-6622)(.909) = 6019. The second row in column 8 = (1902) $\frac{1}{(1.1)^2}$. From Table 14 it is found that $\frac{1}{(1.1)^2}$ = .826. Therefore, the second entry is +1571. The third entry is (-381)(.751) = -286, and so on for each row entry.

The sum of entries in worksheet column 8 is -$30.62 when column 8 row entries are not rounded. This can be rounded to -$30 or -$31. We were lucky on our first guess because this result is very close to zero.

To follow the example through, choose a lower interest rate for the computation of entries in worksheet column 9. It must be lower because the present value of column 8 was too low, i.e. it was below zero. Selecting 6% as the discount rate for column 9 yields the results indicated in worksheet column 9. The sum of entries in worksheet column 9 is $1785 when the entries are not rounded. It is clear that 6% is too low a rate.

The graph below is used to estimate the rate of return on the auto mechanics training program of the example. The rate is between 9.5% and 10.0%. To be more precise it is approximately 9.9%.

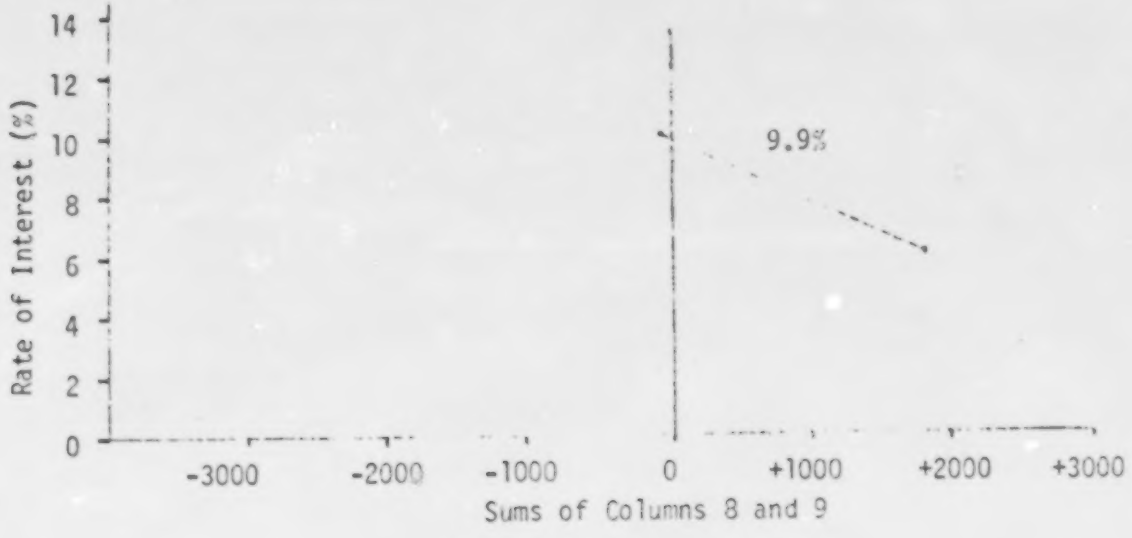


Figure 3

Conclusion

Once the estimated rate of return on a program has been established the question remains, "Is the training program economically justified?" As has been repeatedly stressed, it is if alternative resource uses do not offer higher returns. But how does one determine the rates of return being yielded by alternative resource uses? One defensible measure is the current rate of return on long term government bonds. The yield on such bonds represents an alternative use of long term funds for all investors in the economy. If training projects do not pay at least that rate of

return they cannot be rationally undertaken since the opportunity cost of funds placed in those projects is at least as high as the rate of return on government bonds.

Illustration 1 shows yields current at the time of the study on long term government bonds. Since 9.9%, the yield on the auto mechanics training program, exceeds the yields on long term government bonds as indicated by Illustration 1, it appears to be an economically justifiable program.

Table 11

A TABLE OF EXPECTED WORKING LIFE FOR MEN

YEAR OF AGE	AVERAGE NUMBER OF REMAINING YEARS AS A LABOR FORCE PARTICIPANT
16	45.3
17	44.3
18	43.4
19	42.5
20	41.5
21	40.6
22	39.7
23	38.8
24	37.9
25	37.0
26	36.0
27	35.1
28	34.2
29	33.2
30	32.3
31	31.4
32	30.4
33	29.5
34	28.6
35	27.7
36	26.8
37	25.9
38	25.0
39	24.1
40	23.2
41	22.4
42	21.5
43	20.6
44	19.8
45	18.9
46	18.1
47	17.2
48	16.4
49	15.6
50	14.8
51	14.1
52	13.3
53	12.5
54	11.7
55	11.0

Table 11 (continued)

YEAR OF AGE	AVERAGE NUMBER OF REMAINING YEARS AS A LABOR FORCE PARTICIPANT
56	10.3
57	9.5
58	8.8
59	8.2

Table 12

Present Value of an Annuity of 1 Per Period

Years	Interest Rates							
	4%	4½%	5%	5½%	6%	6½%	7%	7½%
1	0.961	0.957	0.952	0.948	0.943	0.939	0.935	0.930
2	1.886	1.873	1.859	1.846	1.833	1.821	1.808	1.796
3	2.775	2.749	2.723	2.698	2.673	2.648	2.624	2.600
4	3.630	3.587	3.546	3.505	3.465	3.426	3.387	3.349
5	4.452	4.390	4.329	4.270	4.212	4.155	4.100	4.046
6	5.242	5.158	5.076	4.996	4.917	4.841	4.766	4.694
7	6.002	5.893	5.786	5.683	5.582	5.485	5.389	5.297
8	6.733	6.596	6.463	6.334	6.210	6.089	5.971	5.857
9	7.435	7.269	7.108	6.952	6.802	6.656	6.515	6.379
10	8.111	7.913	7.722	7.538	7.360	7.189	7.024	6.864
11	8.760	8.529	8.306	8.093	7.887	7.689	7.499	7.315
12	9.385	9.118	8.863	8.618	8.384	8.159	7.943	7.735
13	9.986	9.683	9.394	9.117	8.853	8.600	8.358	8.126
14	10.563	10.223	9.899	9.590	9.295	9.011	8.745	8.490
15	11.118	10.740	10.380	10.038	9.712	9.408	9.108	8.827
16	11.652	11.234	10.838	10.462	10.106	9.765	9.447	9.142
17	12.166	11.707	11.274	10.865	10.477	10.116	9.763	9.434
18	12.659	12.160	11.690	11.246	10.828	10.432	10.059	9.705
19	13.134	12.593	12.085	11.608	11.158	10.735	10.336	9.959
20	13.590	13.008	12.462	11.950	11.470	11.017	10.594	10.194
21	14.029	13.405	12.821	12.275	11.764	11.285	10.835	10.413
22	14.451	13.784	13.163	12.583	12.042	11.539	11.061	10.617
23	14.857	14.148	13.489	12.875	12.303	11.779	11.272	10.807
24	15.247	14.495	13.799	13.152	12.550	12.006	11.469	10.983
25	15.622	14.828	14.094	13.414	12.783	12.219	11.654	11.147
26	15.983	15.147	14.375	13.662	13.003	12.419	11.826	11.299
27	16.330	15.451	14.643	13.898	13.211	12.607	11.987	11.441
28	16.663	15.743	14.898	14.121	13.406	12.783	12.137	11.573
29	16.984	16.022	15.141	14.333	13.591	12.948	12.278	11.696
30	17.292	16.289	15.372	14.534	13.765	13.102	12.409	11.810
31	17.588	16.544	15.593	14.725	13.929	13.247	12.532	11.917
32	17.873	16.789	15.803	14.906	14.084	13.384	12.647	12.015
33	18.148	17.023	16.002	15.078	14.230	13.512	12.754	12.107
34	18.411	17.247	16.193	15.241	14.368	13.633	12.854	12.193
35	18.665	17.461	16.374	15.396	14.498	13.746	12.948	12.272
36	18.908	17.666	16.547	15.543	14.621	13.851	13.035	12.347
37	19.143	17.861	16.711	15.683	14.737	13.951	13.117	12.415
38	19.368	18.048	16.868	15.815	14.846	14.043	13.193	12.479
39	19.584	18.228	17.017	15.939	14.949	14.131	13.265	12.539
40	19.793	18.401	17.159	16.056	15.046	14.213	13.332	12.594
41	19.993	18.566	17.294	16.167	15.138	14.291	13.394	12.646
42	20.185	18.724	17.423	16.272	15.225	14.364	13.452	12.694
43	20.371	18.874	17.546	16.373	15.306	14.432	13.507	12.738
44	20.549	19.018	17.663	16.468	15.383	14.497	13.558	12.780
45	20.720	19.155	17.774	16.559	15.456	14.558	13.606	12.819
46	20.885	19.287	17.880	16.645	15.524	14.616	13.650	12.855
47	21.043	19.413	17.981	16.727	15.589	14.671	13.692	12.888
48	21.196	19.534	18.077	16.806	15.650	14.723	13.731	12.919
49	21.343	19.651	18.169	16.882	15.708	14.772	13.767	12.948
50	21.482	19.762	18.256	16.954	15.762	14.818	13.801	12.975

Equal annual amounts; payable at *end of year.*

Years	Interest Rates							
	8%	9%	10%	11%	12%	13%	14%	15%
1	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870
2	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.625
3	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283
4	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855
5	3.993	3.889	3.791	3.696	3.605	3.517	3.433	3.352
6	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.785
7	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160
8	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487
9	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772
10	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019
11	7.139	6.805	6.495	6.206	5.938	5.687	5.453	5.234
12	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421
13	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583
14	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724
15	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847
16	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954
17	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047
18	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128
19	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198
20	9.818	9.128	8.514	7.963	7.469	7.025	6.623	6.259
21	10.017	9.292	8.649	8.075	7.562	7.102	6.687	6.312
22	10.201	9.442	8.772	8.176	7.645	7.170	6.743	6.359
23	10.371	9.580	8.883	8.266	7.718	7.230	6.792	6.399
24	10.529	9.707	8.985	8.348	7.784	7.283	6.835	6.434
25	10.675	9.823	9.077	8.422	7.843	7.330	6.873	6.464
26	10.810	9.929	9.161	8.488	7.896	7.372	6.906	6.491
27	10.935	10.026	9.237	8.548	7.943	7.409	6.935	6.514
28	11.051	10.116	9.307	8.602	7.984	7.441	6.961	6.534
29	11.158	10.198	9.370	8.650	8.022	7.470	6.983	6.551
30	11.258	10.274	9.427	8.694	8.055	7.496	7.003	6.566
31	11.350	10.343	9.479	8.733	8.085	7.518	7.020	6.579
32	11.435	10.406	9.526	8.769	8.112	7.538	7.035	6.591
33	11.514	10.464	9.569	8.801	8.135	7.556	7.048	6.600
34	11.587	10.519	9.609	8.829	8.157	7.572	7.060	6.609
35	11.655	10.567	9.644	8.855	8.176	7.586	7.070	6.617
36	11.717	10.612	9.676	8.879	8.192	7.598	7.079	6.623
37	11.775	10.653	9.706	8.900	8.207	7.609	7.087	6.629
38	11.829	10.691	9.733	8.919	8.221	7.618	7.094	6.634
39	11.879	10.726	9.757	8.936	8.233	7.627	7.100	6.638
40	11.925	10.757	9.779	8.951	8.244	7.634	7.105	6.642
41	11.967	10.786	9.799	8.965	8.253	7.641	7.110	6.645
42	12.007	10.813	9.817	8.977	8.262	7.647	7.115	6.648
43	12.043	10.838	9.835	8.989	8.270	7.652	7.118	6.650
44	12.077	10.862	9.851	8.999	8.276	7.657	7.122	6.652
45	12.108	10.884	9.863	9.008	8.283	7.661	7.125	6.654
46	12.137	10.905	9.875	9.016	8.288	7.664	7.126	6.656
47	12.164	10.924	9.887	9.024	8.293	7.668	7.128	6.657
48	12.189	10.942	9.897	9.031	8.297	7.671	7.130	6.658
49	12.212	10.958	9.906	9.037	8.301	7.673	7.131	6.660
50	12.234	10.974	9.915	9.042	8.305	7.675	7.133	6.661

Equal annual amounts; payable at *end of year.*

Table 13

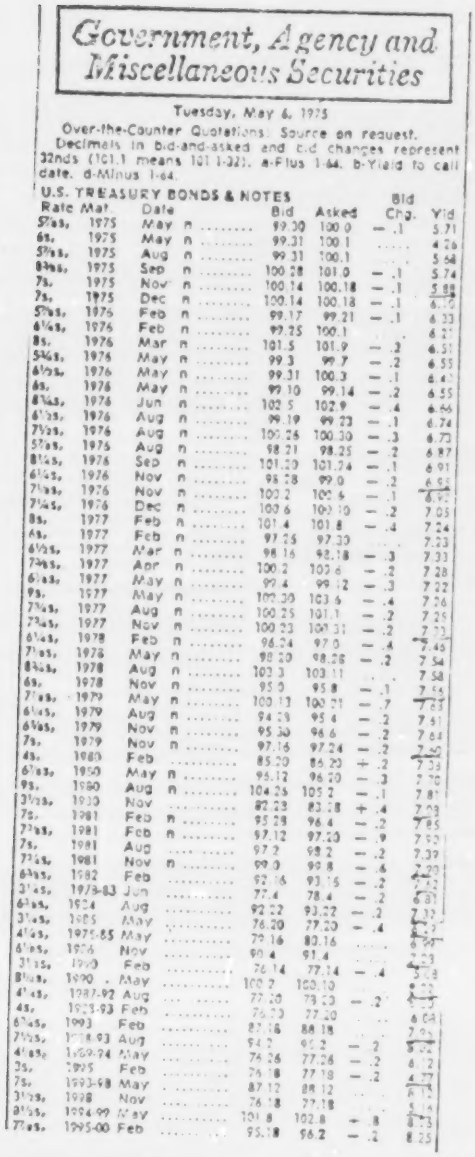
Years from Present	Maturing Date	Yield	Average Yield
1	1975	5.88	
2	1976	6.95	
3	1977	7.33	
4	1978	7.56	6.93% 4 year average (tools)
5	1979	7.60	
6	1980	7.80	
7	1981	7.90	
8	1982	7.62	7.33% 8 year average (machine)
9	1983	7.62	
10	1984	7.32	
11	1985	6.29	
12	1986	7.28	
13	1987	7.28	
14	1988	7.28	
15	1989	7.28	
16	1990	8.22	
17	1991	8.22	
18	1992	8.22	
19	1993	6.08	
20	1994	6.08	
21	1995	4.17	
22	1996	4.17	
23	1997	4.17	
24	1998	5.16	
25	1999	5.16	
26	2000	5.16	
27	2001	5.16	
28	2002	5.16	
29	2003	5.16	
30	2004	5.16	6.48% 30 year average (building)

Table 14

Present Value of $1

Years Hence	1%	2%	4%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1	0.990	0.980	0.962	0.943	0.926	0.909	0.893	0.877	0.870	0.862	0.847	0.833	0.820	0.806	0.800	0.794	0.781	0.769	0.741	0.714	0.690	0.667
2	0.980	0.961	0.925	0.890	0.857	0.826	0.797	0.769	0.756	0.743	0.718	0.694	0.672	0.650	0.640	0.630	0.610	0.592	0.549	0.510	0.476	0.444
3	0.971	0.942	0.889	0.840	0.794	0.751	0.712	0.675	0.658	0.641	0.609	0.579	0.551	0.524	0.512	0.500	0.477	0.455	0.406	0.364	0.328	0.296
4	0.961	0.924	0.855	0.792	0.735	0.683	0.636	0.592	0.572	0.552	0.516	0.482	0.451	0.423	0.410	0.397	0.373	0.350	0.301	0.260	0.226	0.198
5	0.951	0.906	0.822	0.747	0.681	0.621	0.567	0.519	0.497	0.476	0.437	0.402	0.370	0.341	0.328	0.315	0.291	0.269	0.223	0.186	0.156	0.132
6	0.942	0.888	0.790	0.705	0.630	0.564	0.507	0.456	0.432	0.410	0.370	0.335	0.303	0.275	0.262	0.250	0.227	0.207	0.165	0.133	0.108	0.088
7	0.933	0.871	0.760	0.665	0.583	0.513	0.452	0.400	0.376	0.354	0.314	0.279	0.249	0.222	0.210	0.198	0.178	0.159	0.122	0.095	0.074	0.059
8	0.923	0.853	0.731	0.627	0.540	0.467	0.404	0.351	0.327	0.305	0.266	0.233	0.204	0.179	0.168	0.157	0.139	0.123	0.091	0.068	0.051	0.039
9	0.914	0.837	0.703	0.592	0.500	0.424	0.361	0.308	0.284	0.263	0.225	0.194	0.167	0.144	0.134	0.125	0.108	0.094	0.067	0.048	0.035	0.026
10	0.905	0.820	0.676	0.558	0.463	0.386	0.322	0.270	0.247	0.227	0.191	0.162	0.137	0.116	0.107	0.099	0.085	0.073	0.050	0.035	0.024	0.017
11	0.896	0.804	0.650	0.527	0.429	0.350	0.287	0.237	0.215	0.195	0.162	0.135	0.112	0.094	0.086	0.079	0.066	0.056	0.037	0.025	0.017	0.012
12	0.887	0.788	0.625	0.497	0.397	0.319	0.257	0.208	0.187	0.168	0.137	0.112	0.092	0.076	0.069	0.062	0.052	0.043	0.027	0.018	0.012	0.008
13	0.879	0.773	0.601	0.469	0.368	0.290	0.229	0.182	0.163	0.145	0.116	0.093	0.075	0.061	0.055	0.050	0.040	0.033	0.020	0.013	0.008	0.005
14	0.870	0.758	0.577	0.442	0.340	0.263	0.205	0.160	0.141	0.125	0.099	0.078	0.062	0.049	0.044	0.039	0.032	0.025	0.015	0.009	0.006	0.003
15	0.861	0.743	0.555	0.417	0.315	0.239	0.183	0.140	0.123	0.108	0.084	0.065	0.051	0.040	0.035	0.031	0.025	0.020	0.011	0.006	0.004	0.002
16	0.853	0.728	0.534	0.394	0.292	0.218	0.163	0.123	0.107	0.093	0.071	0.054	0.042	0.032	0.028	0.025	0.019	0.015	0.008	0.005	0.003	0.002
17	0.844	0.714	0.513	0.371	0.270	0.198	0.146	0.108	0.093	0.080	0.060	0.045	0.034	0.026	0.023	0.020	0.015	0.012	0.006	0.003	0.002	0.001
18	0.836	0.700	0.494	0.350	0.250	0.180	0.130	0.095	0.081	0.069	0.051	0.038	0.028	0.021	0.018	0.016	0.012	0.009	0.005	0.002	0.001	0.001
19	0.828	0.686	0.475	0.331	0.232	0.164	0.116	0.083	0.070	0.060	0.043	0.031	0.023	0.017	0.014	0.012	0.009	0.007	0.003	0.002	0.001	
20	0.820	0.673	0.456	0.312	0.215	0.149	0.104	0.073	0.061	0.051	0.037	0.026	0.019	0.014	0.012	0.010	0.007	0.005	0.002	0.001	0.001	
21	0.811	0.660	0.439	0.294	0.199	0.135	0.093	0.064	0.053	0.044	0.031	0.022	0.015	0.011	0.009	0.008	0.006	0.004	0.002	0.001		
22	0.803	0.647	0.422	0.278	0.184	0.123	0.083	0.056	0.046	0.038	0.026	0.018	0.013	0.009	0.007	0.006	0.004	0.003	0.001	0.001		
23	0.795	0.634	0.406	0.262	0.170	0.112	0.074	0.049	0.040	0.033	0.022	0.015	0.010	0.007	0.006	0.005	0.003	0.002	0.001			
24	0.788	0.622	0.390	0.247	0.158	0.102	0.066	0.043	0.035	0.028	0.019	0.013	0.008	0.006	0.005	0.004	0.003	0.002	0.001			
25	0.780	0.610	0.375	0.233	0.146	0.092	0.059	0.038	0.030	0.024	0.016	0.010	0.007	0.005	0.004	0.003	0.002	0.001	0.001			
26	0.772	0.598	0.361	0.220	0.135	0.084	0.053	0.033	0.026	0.021	0.014	0.009	0.006	0.004	0.003	0.002	0.002	0.001				
27	0.764	0.586	0.347	0.207	0.125	0.076	0.047	0.029	0.023	0.018	0.011	0.007	0.005	0.003	0.002	0.002	0.001	0.001				
28	0.757	0.574	0.333	0.196	0.116	0.069	0.042	0.026	0.020	0.016	0.010	0.006	0.004	0.002	0.002	0.002	0.001	0.001				
29	0.749	0.563	0.321	0.185	0.107	0.063	0.037	0.022	0.017	0.014	0.008	0.005	0.003	0.002	0.002	0.001	0.001	0.001				
30	0.742	0.552	0.308	0.174	0.099	0.057	0.033	0.020	0.015	0.012	0.007	0.004	0.003	0.002	0.001	0.001	0.001					
40	0.672	0.453	0.208	0.097	0.046	0.022	0.011	0.005	0.004	0.003	0.001	0.001										
50	0.608	0.372	0.141	0.054	0.021	0.009	0.003	0.001	0.001	0.001												

Illustration 1



Government, Agency and Miscellaneous Securities

Tuesday, May 6, 1975

Over-the-Counter Quotations: Source on request.
Decimals in bid-and-asked and bid changes represent 32nds (101.1 means 101 1-32). a-Plus 1-64. b-Yield to call date. d-Minus 1-64.

U.S. TREASURY BONDS & NOTES

Rate	Mat.	Date		Bid	Asked	Bid Chg.	Yld
5⅞s,	1975	May	n	99.30	100.0	— .1	5.71
6s,	1975	May	n	99.31	100.1	.....	4.26
5⅞s,	1975	Aug	n	99.31	100.1	.....	5.68
8⅜s,	1975	Sep	n	100.28	101.0	— .1	5.74
7s,	1975	Nov	n	100.14	100.18	— .1	5.88
7s,	1975	Dec	n	100.14	100.18	— .1	6.0
5⅞s,	1976	Feb	n	99.17	99.21	— .1	6.23
6¼s,	1976	Feb	n	99.25	100.1	.....	6.27
8s,	1976	Mar	n	101.5	101.9	— .2	6.51
5¾s,	1976	May	n	99.3	99.7	— .2	6.55
6⅛s,	1976	May	n	99.31	100.3	— .1	6.4
6s,	1976	May	n	99.10	99.14	— .2	6.55
8¼s,	1976	Jun	n	102.5	102.9	— .4	6.66
6⅛s,	1976	Aug	n	99.19	99.23	— .1	6.74
7½s,	1976	Aug	n	100.26	100.30	— .3	6.73
5⅞s,	1976	Aug	n	98.21	98.25	— .2	6.87
8⅛s,	1976	Sep	n	101.20	101.24	— .1	6.91
6¼s,	1976	Nov	n	98.28	99.0	— .2	6.95
7⅛s,	1976	Nov	n	100.2	100.6	— .1	6.97
7¼s,	1976	Dec	n	100.6	100.10	— .2	7.05
8s,	1977	Feb	n	101.4	101.8	— .4	7.24
6s,	1977	Feb	n	97.26	97.30	.....	7.23
6½s,	1977	Mar	n	98.16	98.18	— .3	7.33
7¾s,	1977	Apr	n	100.2	100.6	— .2	7.28
6¼s,	1977	May	n	99.4	99.12	— .3	7.22
9s,	1977	May	n	103.30	103.6	— .4	7.26
7¾s,	1977	Aug	n	100.25	101.1	— .2	7.25
7¾s,	1977	Nov	n	100.23	101.31	— .2	7.23
6¼s,	1978	Feb	n	96.24	97.0	— .4	7.45
7¼s,	1978	May	n	98.20	98.26	— .2	7.54
8¾s,	1978	Aug	n	103.3	103.11	.....	7.58
6s,	1978	Nov	n	95.0	95.8	— .1	7.55
7¼s,	1979	May	n	100.13	100.21	— .7	7.25
6¼s,	1979	Aug	n	94.28	95.4	— .2	7.51
6⅛s,	1979	Nov	n	95.30	96.6	— .2	7.64
7s,	1979	Nov	n	97.16	97.24	— .2	7.60
4s,	1980	Feb		85.20	86.20	+ .2	7.53
6⅞s,	1980	May	n	96.12	96.20	— .3	7.70
9s,	1980	Aug	n	104.26	105.2	— .1	7.81
3½s,	1980	Nov		82.28	83.28	+ .4	7.08
7s,	1981	Feb	n	95.28	96.4	— .2	7.85
7⅞s,	1981	Feb	n	97.12	97.20	— .9	7.93
7s,	1981	Aug		97.2	98.2	— .2	7.39
7¾s,	1981	Nov	n	99.0	99.8	— .6	7.90
6¾s,	1982	Feb		92.16	93.16	— .2	7.52
3½s,	1978-83	Jun		77.4	78.4	— .2	6.81
6½s,	1984	Aug		92.22	93.22	— .2	7.32
3½s,	1985	May		76.20	77.20	— .4	6.79
4¼s,	1975-85	May		79.16	80.16	.....	6.94
6½s,	1986	Nov		90.4	91.4	.....	7.23
3½s,	1990	Feb		76.14	77.14	— .4	5.88
8¼s,	1990	May		100.2	100.10	.....	8.22
4¼s,	1987-92	Aug		77.20	78.20	— .2	6.3
4s,	1988-93	Feb		76.20	77.20	.....	6.04
6¾s,	1993	Feb		87.16	88.16	.....	7.94
7½s,	1988-93	Aug		94.2	95.2	— .2	8.04
4¼s,	1969-94	May		76.26	77.26	— .2	6.12
3s,	1995	Feb		76.18	77.18	— .2	4.77
7s,	1993-98	May		87.12	88.12	.....	8.15
3½s,	1998	Nov		76.18	77.18	.....	5.16
8½s,	1994-99	May		101.8	102.8	— .8	8.23
7¾s,	1995-00	Feb		95.18	96.2	— .2	8.25

APPENDIX C

Original Project Objectives and Methodology

Objectives

1. Demonstrate the feasibility of cost-benefit analysis as a source of information for local vocational administrators.

2. Document the use of cost-benefit information by local vocational administrators.

3. Evaluate the effectiveness of a workshop for training local vocational administrators to conduct cost-benefit analysis investigations.

4. Identify existing barriers and constraints that might prevent local vocational administrators from using cost-benefit analysis in program development and evaluation.

Methodology

Task 1. Establish cooperative relationships and joint sponsorship of the project with representatives of the Colorado Council of Local Administrators (CCLA) and the State Board for Community Colleges and Occupational Education (SBCCOE).

Procedure: Distribute copies of the funded proposal to selected individuals representing SBCCOE and CCLA, with an invitation to meet as a steering committee to plan an in-service training workshop and select participants.

Task 2: Conduct a six-hour workshop to train fifteen participants to conduct a cost-benefit analysis of a local vocational education program.

Procedure: Implement the plan developed in Task 1.

Task 3. Follow-up participants to encourage and assist them in completing a cost-benefit analysis of at least one local vocational program.

Procedure. Visit participants and work with them as needed while the cost-benefit analysis study is in process.

Task 4. Monitor subsequent decision making activities by the participants and their colleagues to ascertain the impact of the cost-benefit analysis on administrative decisions.

Procedure. Gather pertinent data by periodic follow-up interviews with participants and others. Conduct a participant debriefing and idea-sharing meeting during CVA.

Task 5. Evaluate the effectiveness of the workshop and instructional materials.

Procedure: Have participants complete evaluation forms at the end of the workshop sessions and during the debriefing session at CVA. Interpret information obtained formally and informally as tasks 1 through 4 are in process.

Task 6. Produce a descriptive report pertaining to the four objectives listed in B above. Submit copies to the Steering Committee and CORCU.

Procedure. Summarize and interpret data gathering during steps 1 through 5.

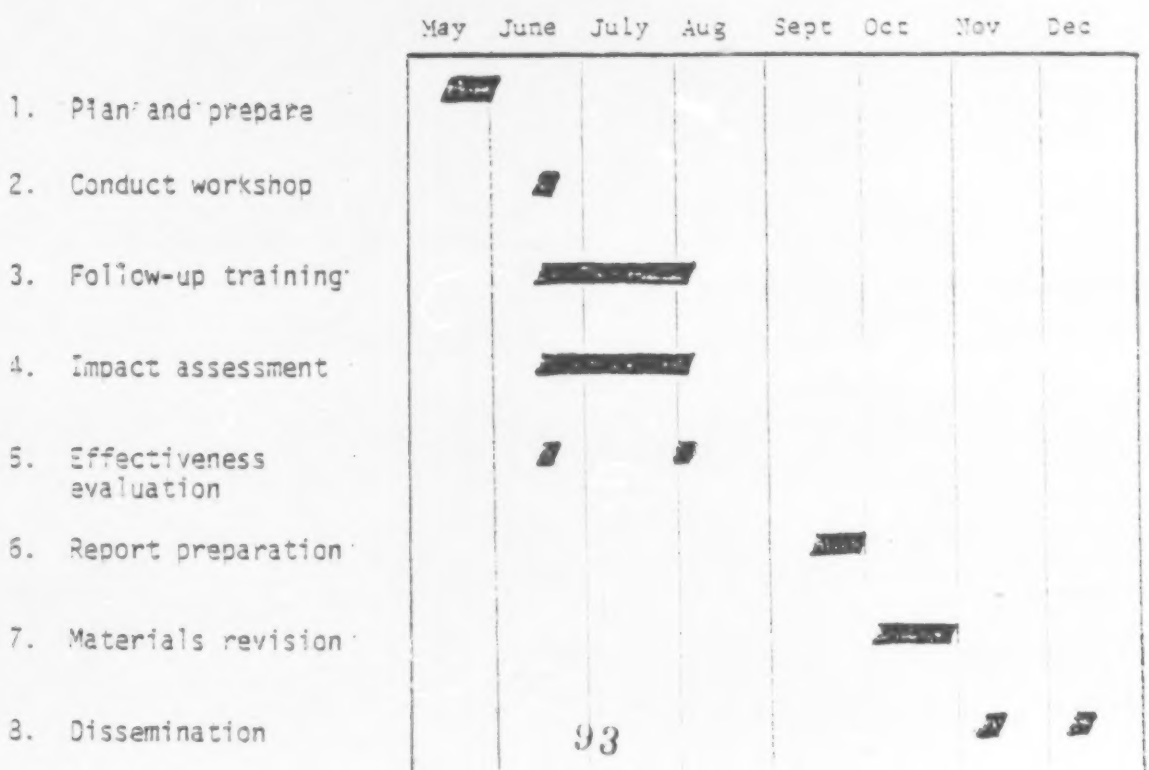
Task 7. As necessary, revise instructional materials and produce a manual of materials and guidelines for in-service training of local administrators to conduct cost-benefit analysis of vocational programs.

Procedure: Review the report prepared in task 6 with the steering committee employed in task 1. Obtain suggestions for revision of materials and future in-service training program design. Revise the materials and write guidelines. Submit 10 copies to the CORCU.

Task 8. Reaffirm joint sponsorship of the project with representatives of CCLA and SBCCOE, and plan for subsequent dissemination and training activities.

Procedure: Meet with the steering committee to review and evaluate progress-to-date. Plan for any future dissemination of materials and in-service training. Determine possible future funding sources and arrangements and initiate appropriate proposal writing efforts, as needed.

Timeline:



APPENDIX D

Vocational Education Outcome Questions

VOCATIONAL EDUCATION OUTCOME QUESTIONS: ILLUSTRATION OF THE RANGE AND DIVERSITY OF POSSIBLE OUTCOMES

No.	Outcome Questions	Thematic Area
1.	Do students become occupationally proficient and ready for entry-level employment as a result of completing a vocational program?	Skill acquisition
2.	What proportion of former vocational students are employed in training-related jobs six months following program completion?	Employment in training-related jobs
3.	Are dropout rates lower for vocational students than for comparable students enrolled in general/academic curricula at the secondary school level?	Schooling
4.	Do vocational programs at all levels--high school, postsecondary, and adult--significantly strengthen the human resource base of the local and state economy?	Economic development
5.	One year following program completion, are former vocational students earning higher hourly wages than comparable, general/academic students in similar jobs?	Wage rates
6.	Are the parents of students who are enrolled in vocational programs better satisfied with the overall high school program than parents of students enrolled in general/academic curricula?	Parental satisfaction with school program
7.	Do vocational students obtain jobs which they consider acceptable, whether in training-related fields or not, within a specified time period following program completion?	Employment
8.	Are vocational programs more effective or less effective than general/academic curricula in enhancing the self-image and self-confidence of students who are preparing for employment?	Student self-image

continued ⟶

VOCATIONAL EDUCATION OUTCOME QUESTIONS: ILLUSTRATION OF THE RANGE AND DIVERSITY OF POSSIBLE OUTCOMES

No.	Outcome Questions	Thematic Area
9.	Do vocational students receive higher employer ratings than comparable general/academic students following a specified period of employment?	Employer assessment of students
10.	Do vocational students develop leadership ability through their participation in occupationally-related youth programs such as Distributive Education Clubs of America (DECA), Future Homemakers of America (FHA), Future Farmers of America (FFA), and Vocational Industrial Clubs of America (VICA)?	Leadership development
11.	Are students who are currently enrolled in vocational programs better satisfied with their overall school experience than comparable students enrolled in general/academic curricula?	Student satisfaction with schooling
12.	Do graduates of vocational programs express more, less, or the same job satisfaction as comparable graduates of general/academic programs holding similar jobs?	Job satisfaction
13.	Does participation in high school vocational programs reduce the incidence of school vandalism and other antisocial behavior on the part of students?	Antisocial behavior
14.	Does vocational education (high school, postsecondary, adult) provide its graduates with a general set of skills and basic work disciplines that significantly increase their chances for successful employment?	Employability development

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VOCATIONAL EDUCATION OUTCOME QUESTIONS: ILLUSTRATION OF THE RANGE AND DIVERSITY OF POSSIBLE OUTCOMES

No.	Outcome Questions	Thematic Area
15.	By completing a vocational program, do students acquire job-seeking skills such as how to write a resume, how to participate in an interview, and knowing where to look for job opportunities?	Job-search skills
16.	Do students enrolled in vocational programs learn the basic cognitive skills of speaking, reading, writing, and numerical calculation as effectively as comparable students in academic/general curricula?	Educational achievement
17.	Does participation in a vocational program give students a realistic understanding of what employers will expect of them on the job?	World-of-work understanding
18.	Is the occupational mobility of vocational students limited both horizontally and vertically by the content of the programs (e.g., training in narrow skill areas or in occupations with diminishing job opportunities)?	Occupational mobility
19.	Does participation in a high school vocational program inhibit or enhance a student's opportunities for a college education?	College education
20.	Do students who complete vocational programs have a more realistic understanding of our society and its economic system than comparable students who complete general/academic programs?	Socioeconomic understanding
21.	Are the returns from individual and social investments in vocational education lower, higher, or the same as returns from investments made in general/academic programs below the baccalaureate level?	Economic returns to schooling

continued→

VOCATIONAL EDUCATION OUTCOME QUESTIONS: ILLUSTRATION OF THE RANGE AND DIVERSITY OF POSSIBLE OUTCOMES

No.	Outcome Questions	Thematic Area
22.	Does participation in vocational programs on the high school level contribute measurably to the moral development of students?	Moral development
23.	Through their participation in vocational education programs (e.g., cooperative education, placement in part-time jobs), do disadvantaged minority youth earn more income while still in school than comparable students in general/academic programs?	Student earnings
24.	Do high school, postsecondary, and adult vocational programs increase occupational awareness, training opportunities, and job access for women in both traditional and nontraditional areas?	Employment opportunities for women
25.	Does favorable community reaction to ongoing vocational programs result in general expressions of satisfaction and financial support for the entire local school system?	Community support for education
26.	Do students who have participated in vocational programs on the high school level have more clearly defined occupational goals than those expressed by nonvocational students who enroll for postsecondary education?	Career planning
27.	Do high school home economics courses significantly increase the consumer skills of students who have taken them?	Consumer skills

continued ⟶

VOCATIONAL EDUCATION OUTCOME QUESTIONS: ILLUSTRATION OF THE RANGE AND DIVERSITY OF POSSIBLE OUTCOMES

No.	Outcome Questions	Thematic Area
28.	Do certain admissions and student assignment practices followed in vocational education tend to reduce or to reinforce occupational discrimination on the basis of race, class, or sex?	Occupational discrimination
29.	Is job-search time lower for students who participated in vocational programs, than for comparable workers who did not?	Unemployment
30.	How do the annual earnings of vocational graduates compare with those of general/academic graduates, both in the short term and in the long run?	Earnings